24th Tanners Get-Together, 1989

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28-30 January 1989

Design, Development and Inplant Control for Leather Industry

PREPRINTS

CENTRAL LEATHER RESEARCH INSTITUTE
MADRAS-600 020 INDIA

In association with

COMMITTEE ON SCIENCE AND TECHNOLOGY
IN DEVELOPING COUNTRIES (COSTED)
Madras

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FOREWORD

Tanners Get-Together (TGT) is an annual convention held at Central Leather Research Institute and attended by tanners, leatherware makers, traders, scientists, technologists and policy makers from India and abroad. The main theme of 24th TGT, to be held from 28th to 30th January 1989, is **"Design, Development and Inplant Control for Leather Industry"** which is very apt in the context of present developments in leather industry, not only in India but also in other parts of the world. The 24th TGT is being co-sponsored by the Committee on Science and Technology in Developing Countries (COSTED).

TGT-89 is so structured that there are two technical and one scientific (Poster) sessions which deal with designs,developments and process controls in leather processing and product sectors. Discussions on footwear have been given high importance in TGT-89. The other major events in this TGT are, a panel discussion on manpower, marketing and management for leather industry, views forum, three special lectures and practical demonstrations.

The first technical session deals with design, development and control in leather process technology and comprises of five invited lectures from eminent scientists and technologists in the area. The lectures are on the topics:

* Inplant process control in tanneries

- Microprocessor control systems for tannery wet operations
- Biotechnologies for beam-house operations
- New technologies available for inplant process control in tanneries
- Process technologies with reduced pollution

The second technical session deals with the design development and control in leather products technology and comprises of five invited lectures by the noted technologists in the field. The lectures are on the following topics:

- Design, style and fashion in leather industries
- Modern concepts in shoe designing
- Footwear components
- Trends in footwear fabrication
- Quality control of upper leathers for high fashioned shoes

Manpower, management and marketing needs in leather/products sector will be discussed in panel discussion on 30th January 1989. Many important issues would be dealt with in the panel discussion with Shri TS Vijayaraghavan, Joint Secretary, Ministry of Commerce, Government of India in the Chair.

R&D perspectives in CLRI is to be necessarily geared to the current and immediate needs of the industry. Therefore, CLRI has sought industry's view point in TGT through a separate session.

TGT-89 has the distinction of hosting three important special lectures, viz.

- **Nayudamma Science Foundation Lecture**
- **Nayudamma Memorial Lecture**
- **BM Das Memorial Lecture**

A series of demonstration programmes is included in TGT-89 to enable leading manufacturers of leather, chemicals and computer software to enable show-hows for a new range of technologies/techniques/products. The poster session mainly brings out recent research findings and other technological developments in the leather and allied fields even in early stages of R&D.

This proceedings brings out a compilation of the full text of the invited lectures received and abstracts of the papers to be presented during the poster session. Further this preprint will serve also as a ready reckoner to the users and provides other relevant information on various leather auxiliaries and chemicals.

The TGT has traditionally provided an opportunity for the tanners and scientists to exchange views, renew contacts and impress jointly on the policy makers to evolve suitable measures for the overall promotion of the Indian leather industry. The TGT-89 aims, in addition, further strengthening of institute-industry linkages.

Dr.R.B. Mitra
Director

28 January 1989

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Session - 1

LEATHER PROCESS TECHNOLOGY

INPLANT PROCESS CONTROL IN TANNERIES

Dr. HEINZ PETER GERMANN
(Westdeutsche Gerberschule, FRG)

There are four main arguments for the improvement of process control in tanneries today:

- rationalization
- ensuring of high quality
- safety at the place of work
- and reducing the pollution of the environment.

Measuring the essential process parameters is the first step in process control. Only a correct determination of the parameters like pH and temperature makes it possible to intervene in the process, either manually or automatically.

Regarding the technique of measurement we have to consider

- single point parameter checks, carried out only if a parameter is just required,

- and a continuous check, which is running throughout the process or in short intervals and which is the first step in complete automation.

Data indication is accomplished either by a direct -reading instrument, which gives only actual data, or the more favourable graph-recorder, which allows to retrace an error in the process upto the beginning.

The advantages of digital data indication are easy reading and computer processing.

The precision of any data indication must be appropriate to the requirements.

For example, there is no sense in indicating pH to a hundredth in a process, where a pH variation to a tenth does not influence the quality of the product at all.

In case of the wet-processing steps in leather manufacturing (e.g. tanning, wet-finishing) the control and correction of bath-temperature and pH are above all the indispensable base for a satisfactory process control.

The following figure (fig.1) shows the registrations of a graph-recorder in a temperature and pH controlled system. Graphs for temperature (blue) and pH (red) are indicated from the start of the deiming process upto the end of the chromium tannage.

Point -A: washing after liming process
- -B: start of deliming and bating
- -C: washing
- -D: addition of pickling salt
- -E: addition of pickling acids
- -F: addition of undissolved chromium tanning agent
- -G: addition of (calcinated) soda
- -H: heating to 40° C.

A comparison of these graphs with the standard process graphs shows at once whether the production proceeds in the correct direction.

A very important point is the local position of the control unit in the system. There has to be a sufficient contact with the float at any time. If used in connection with an adjusting device, the position of the control unit should be close to the place of the adjusting addition in order to avoid any over-dosage.

Among the well-established hide processing vessels the mixer is a vessel which can be prepared comparatively easily for process controls and automations (fig. 2). A bypass-system accomplished by float circulation with a mono screw pump provides a good basis for installation of process controlling devices.

* pH is indicated and additions of either acid or alkaline solutions adjusted as required.

* Float temperature is indicated and then corrected either by means of direct steam injection, as shown in the figure or by a heat-exchanger.

* Chemicals are added at the front hole, as shown for water, or into the circulating float as shown in the figure. Here the second way is more favourable for a thorough mixing, which provides a better distribution of the chemicals inside the hide processor.

* Moreover our example includes a float drainage system with recycling and waste water separation as well as devices for drum speed and cycle time control and a weighing system.

In the case of a tanning drum (fig. 3) for a continuous process control, a special float draining device, e.g. a system of collecting channels as shown in figure 4, is required, which continuously draws off a part of the float volume through the hollow axle. This liquor is sent to a mixing and controlling box (fig.5), where pH and temperature may be checked and readjusted by addition of acid or alkaline solutions and by heating, respectively. Heating of the liquor is accomplished either by a heat-exchanger or by direct steam injection (fig.6). From the mixing box the float flows back through the hollow axle into the drum. However, if an even better distribution of the returning float inside the drum seems necessary, as e.g. in the case of chemicals, introduction through the box (fig. 7) during dyeing operations, a system as shown in this figure may be helpful. Here the returning float volume moves first from one side of the drum to the other, which results in a more effective dissolution and uniform distribution of the added chemicals all over the drum.

The flow of the bath through the mixing box may also be used to drain the drum float either by means of a simple valve as shown in the figure or with a separation device for different residual floats, which may be treated individually (e.g. for recycling or waste water treatment) subsequently.

Another system (fig. 8) uses a fixed tube to send back the float from the mixing box to the other side of the drum for achieving an improved dissolution and distribution of the added chemicals. In this case the fixed tube behind the drum is used for heat-exchange over a longer distance.

An example of another kind of modern tanning machines developed in order to achieve a maximum distribution of reagents on the hides and a good compatibility with process automation is the Y-divided "Dosemat". It consists of two cylinders, of which the inner one is perforated in three areas, as shown in the figure (fig. 9), and three float-traverses, which send the float through a channel system to a mixing box on the outside of the rotating drum. This mixing box is the right place for adding water and chemicals and for controlling the float, as well as the temperature and the pH.

The next aim to be achieved in near future is the more or less fully automated tannery, where all wet-processes run in modern hide processing vessels, which are computer-controlled. For parts of wet-processing, future has already started in some highly advanced tanneries all around the world and further development is being made.

If, however, greater interest and more importance is attached to the idea of throughfeed-processing in tanneries during the coming years, completely new technologies will be required, in order to overcome any hide separation step, which is a system immanent for any drum process. The development of such throughfeed processing machines like the "HS-Penetrator" shown by Krause at the Paris Leather Fair (SIC) last year, in September may be a step ahead in the right direction.

Before concluding, please let me mention one more aspect of process control. One of the main arguments for improving the process control system in tanneries was the ensuring of a high quality, which also includes a good re-producibility of any process. However, alth ough bath-temperature and pH are adjusted to the right values and chemicals are added in the right percentage of "hide-weight", there is still an uncertainty arising from a varying content of tannable hide substance (= collagen) in the substrate (e.g. raw hide, wet blue), which may also cause problems in reproducibility. In that case a determination of the moisture content in the substrate would be a useful additional control.

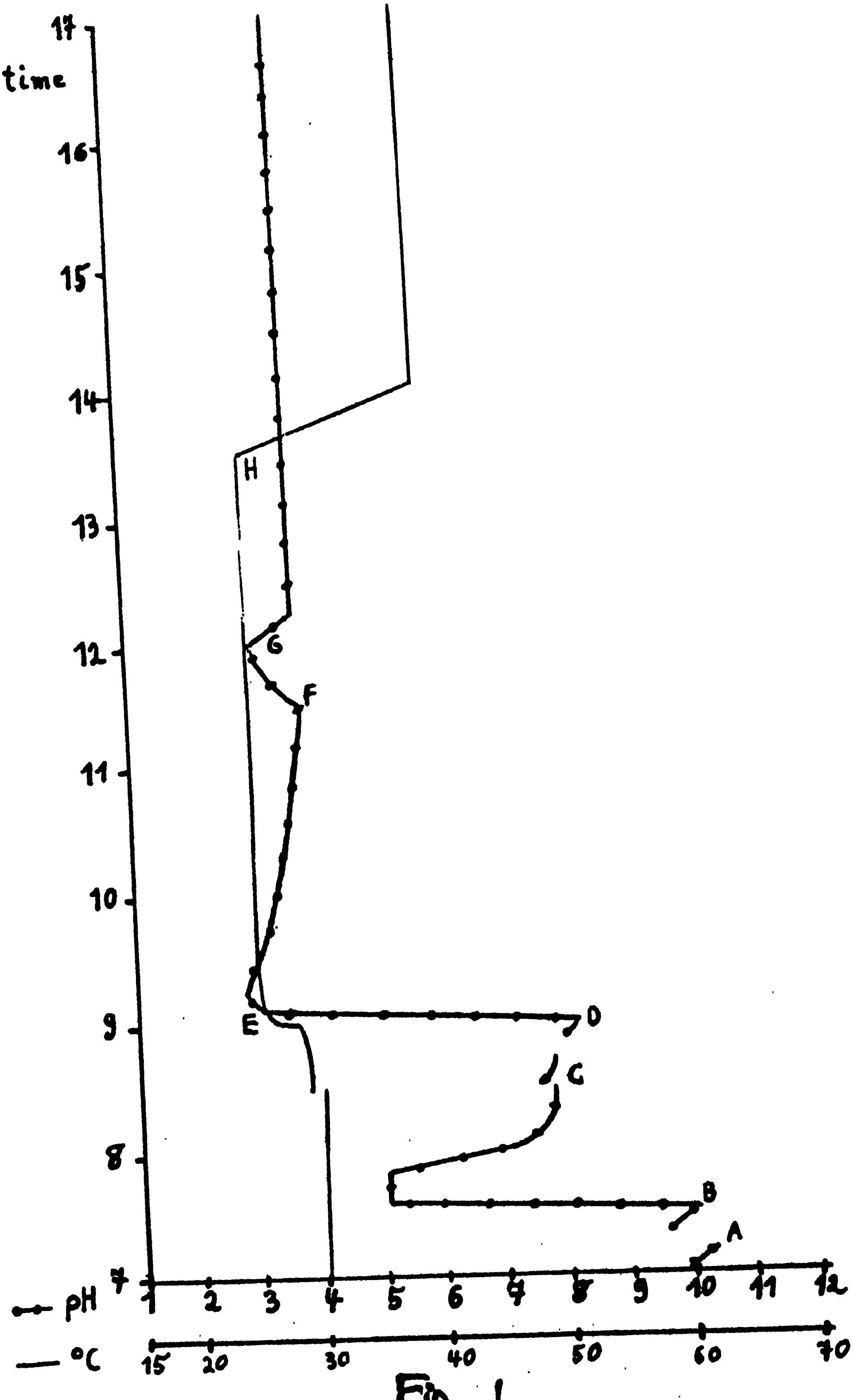

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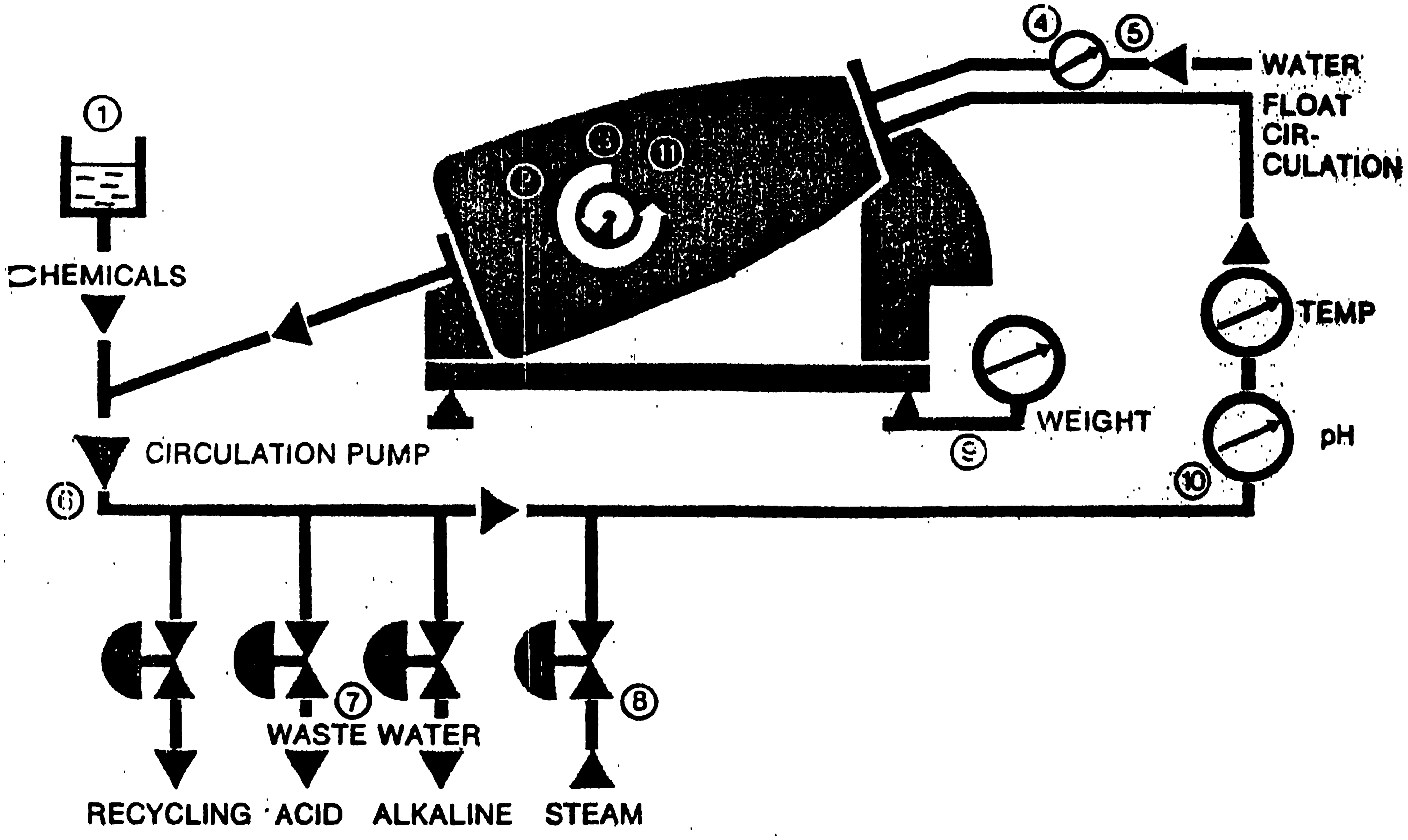
Fig. 1



Chemicals adding	1. Zugabe von Chemikalien	1. Addition des produits chimique
Drum speed control	2. Trommel Drehzahlregelung	2. Contrôle de la vitesse de la cuv
Cycle time programmer	3. Pause-Laufzeit Steuerung	3. Programmeur cyclique
Pre-selection of water quantity	4. Wassermengenvorwahl	4. Présélection de la quantité d'ea
Pre-selection of water temperature	5. Wassertemperaturvorwahl	5. Présélection de la température de l'eau
Float circulation with Mono screw pump or centrifugal pump.	6. Flottenzirkulation mit Mono Pumpe oder mit zentrifugal Pumpe	6. Circulation du bain avec pompe Mono ou pompe centrifuge
Float drainage and separation	7. Entflottung und Abwasserseparierung	7. Vidange et séparation des bains
Temperature control system by steam injection	8. Temperatursteuerung mit Damp-injektion	8. Système de contrôle de la température par injection de vapeur
Weighing system	9. Wiegesystem	9. Système de pesage
PH indication and recording	10. PH Messung und Aufzeichnung	10. Indication et enregistrement du PH
Punch card or computer control for all above functions	11. Programmlochharter oder Computersteuerung für obige Funktionen	11. Commande par programmeur à carte perforée ou par ordinateur de toutes les fonctions sus-mentionnées.

Fig. 2

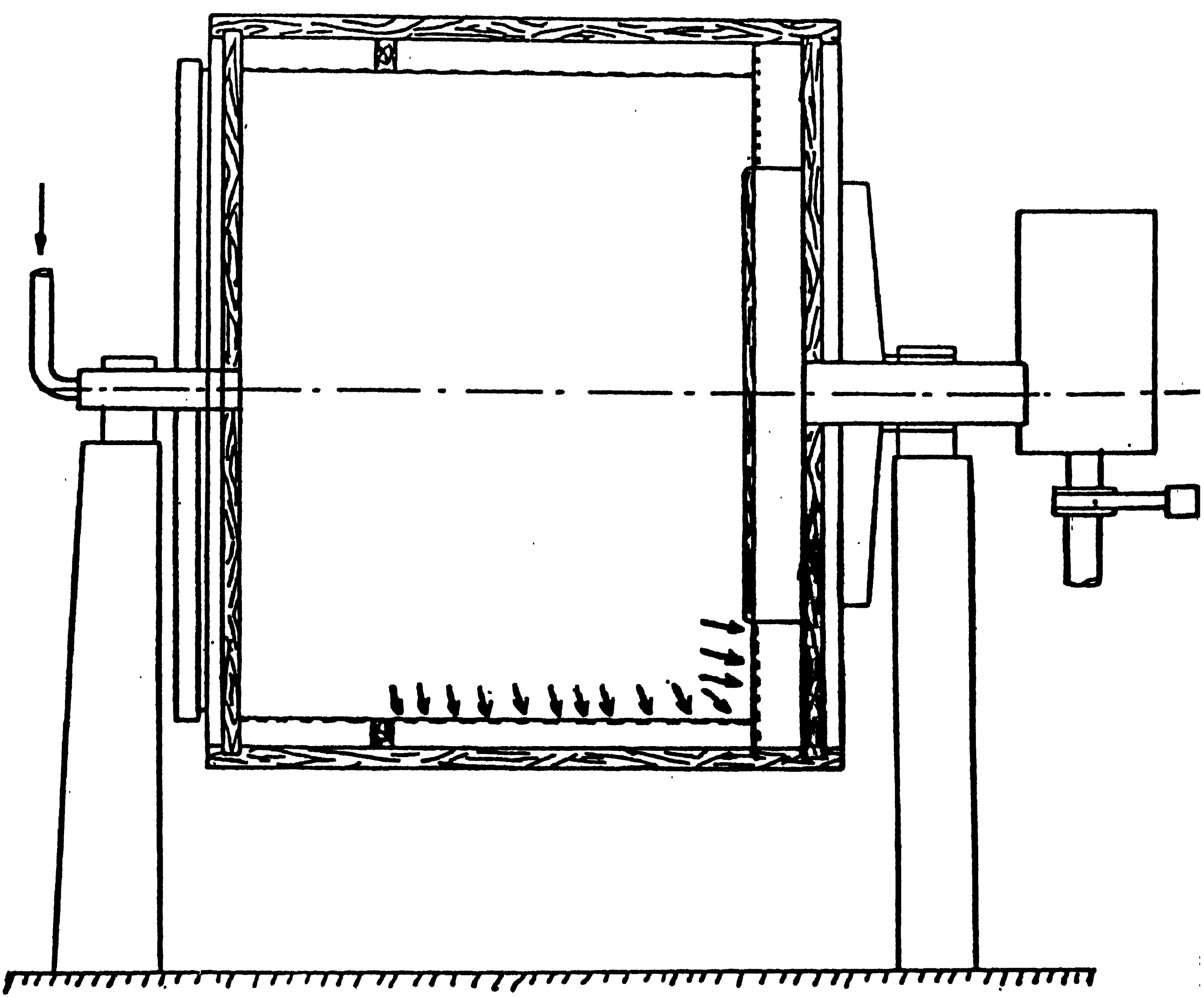


Fig. 3

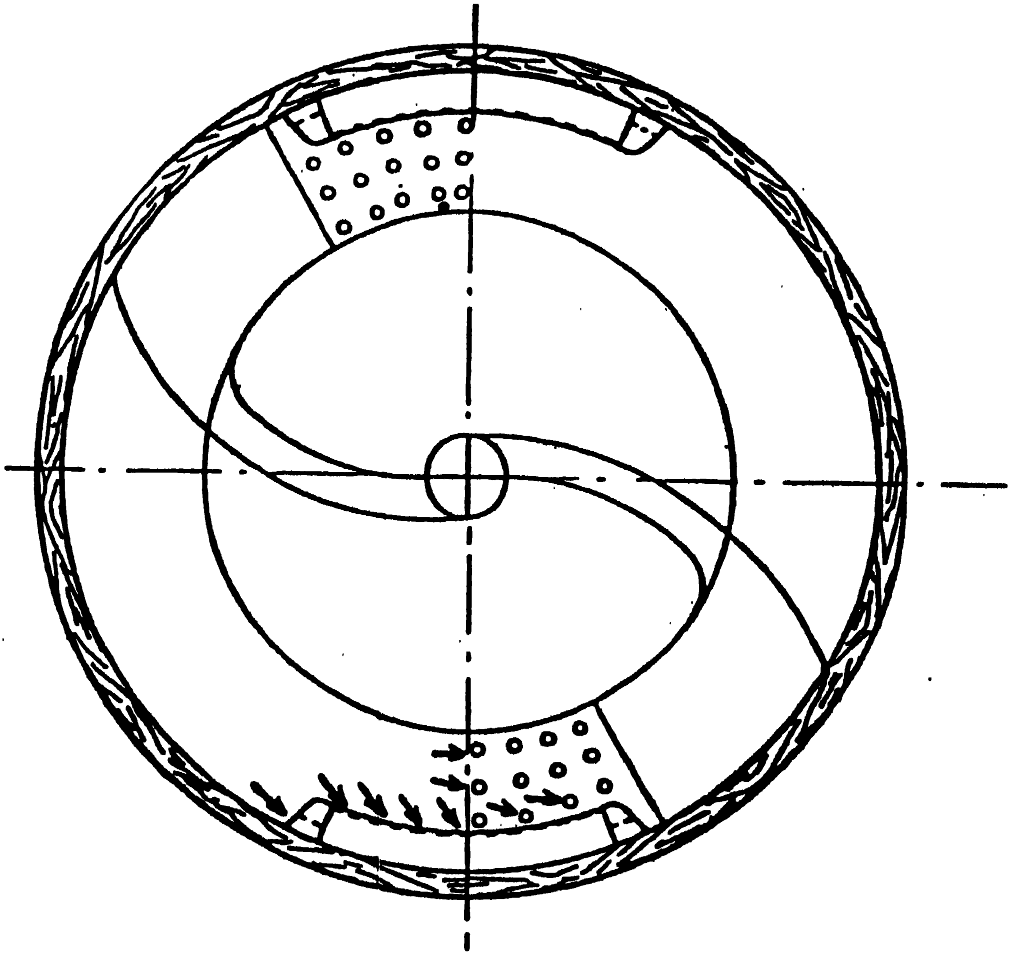


Fig. 4

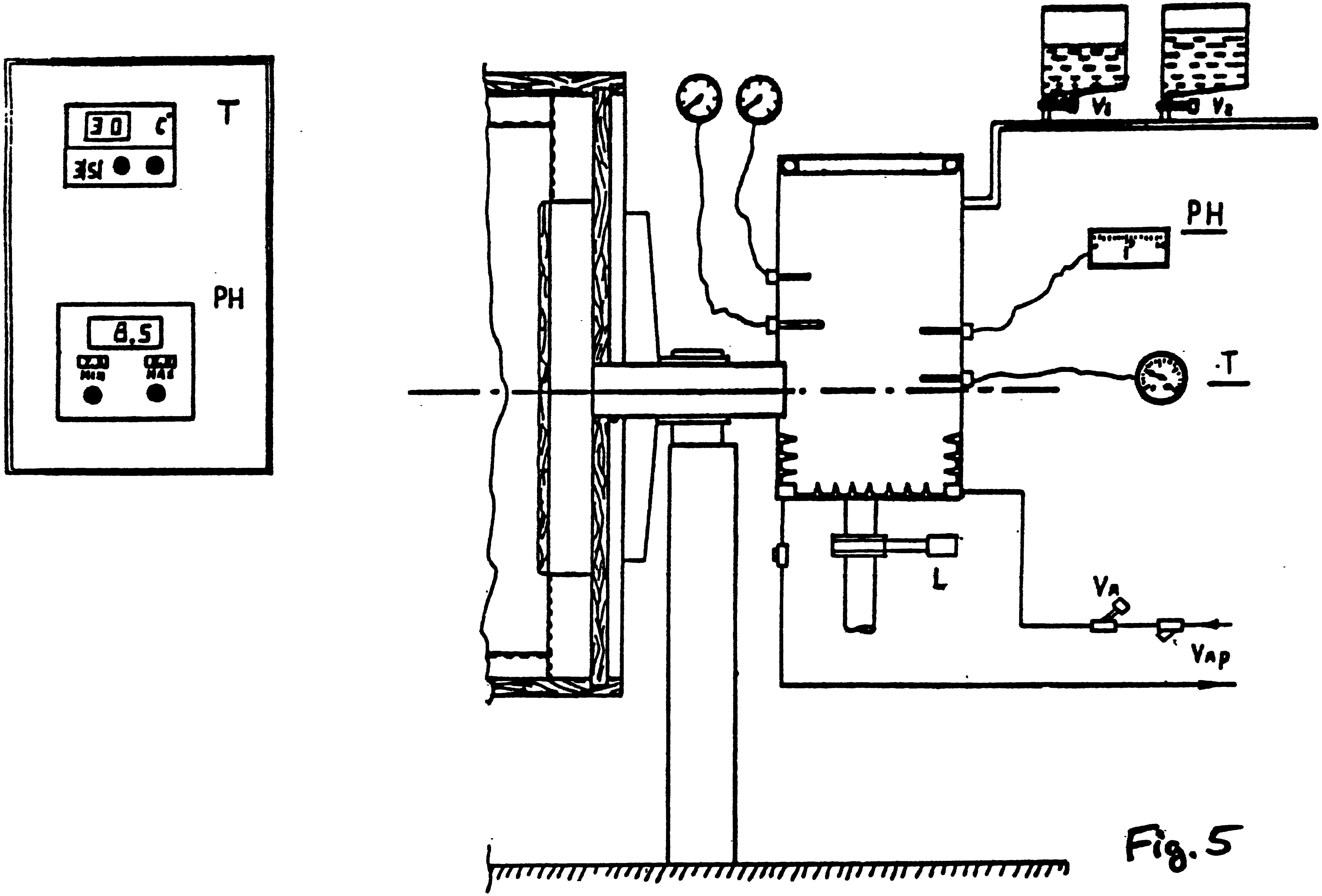


Fig. 5

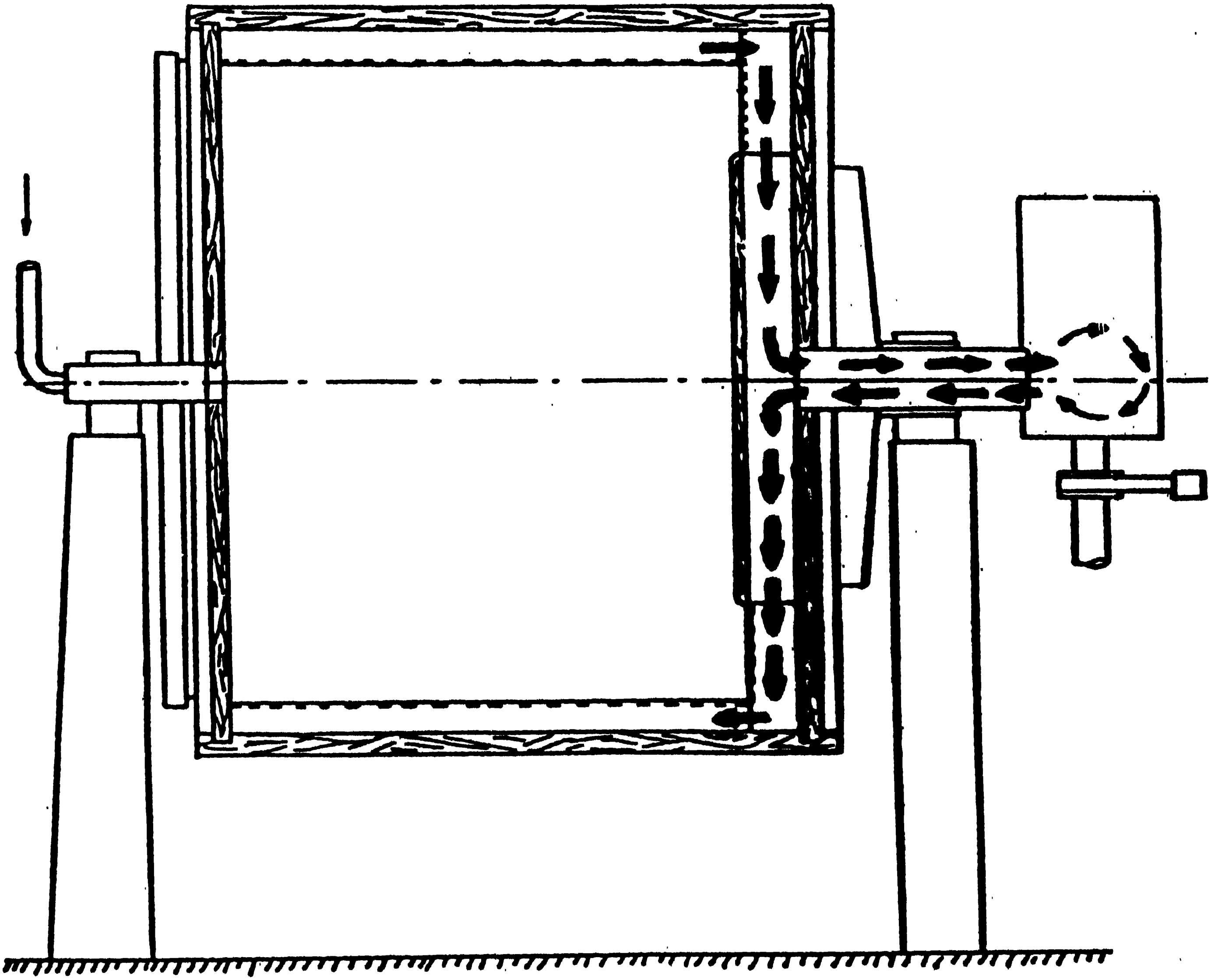


Fig. 6

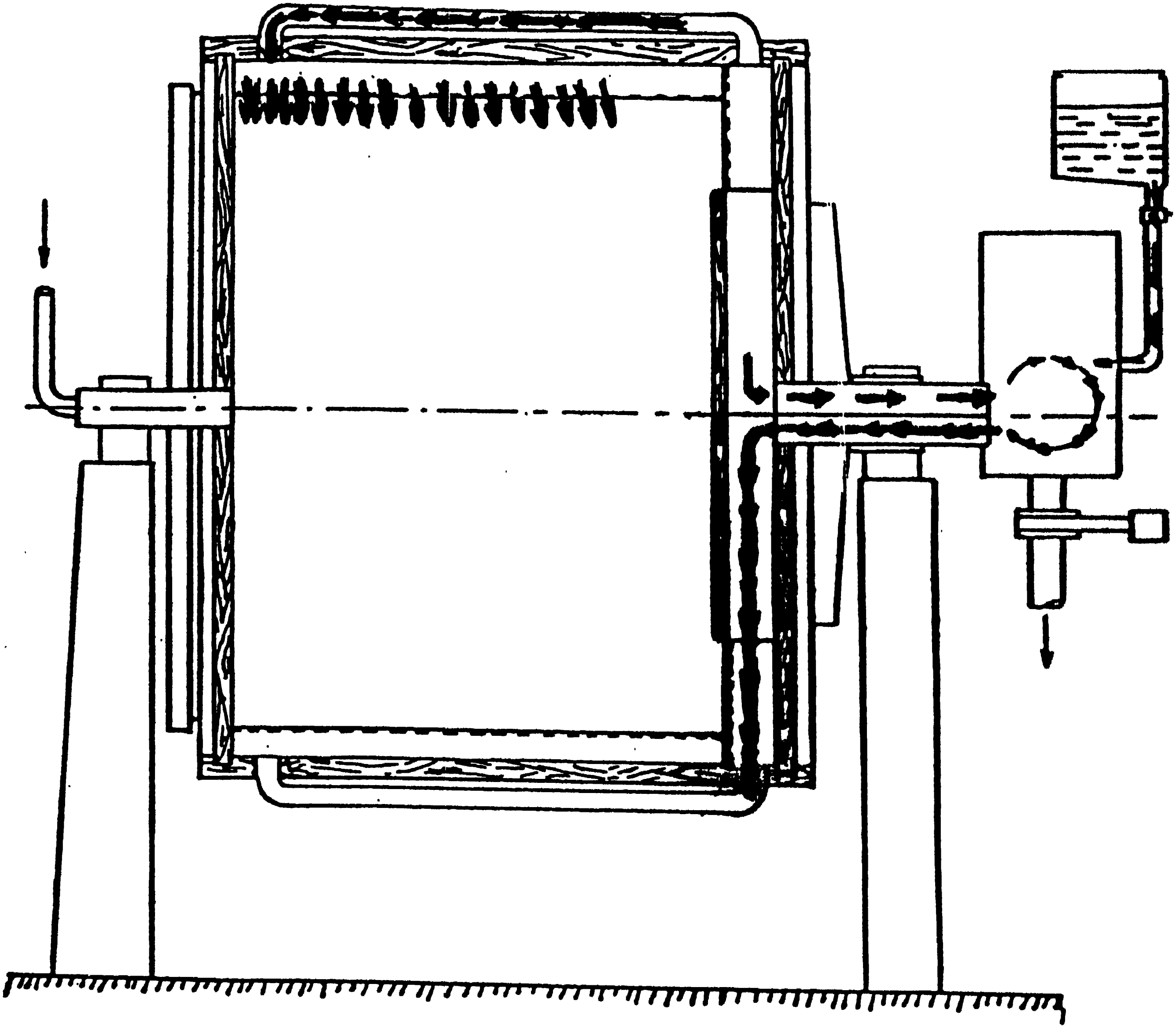


Fig. 7

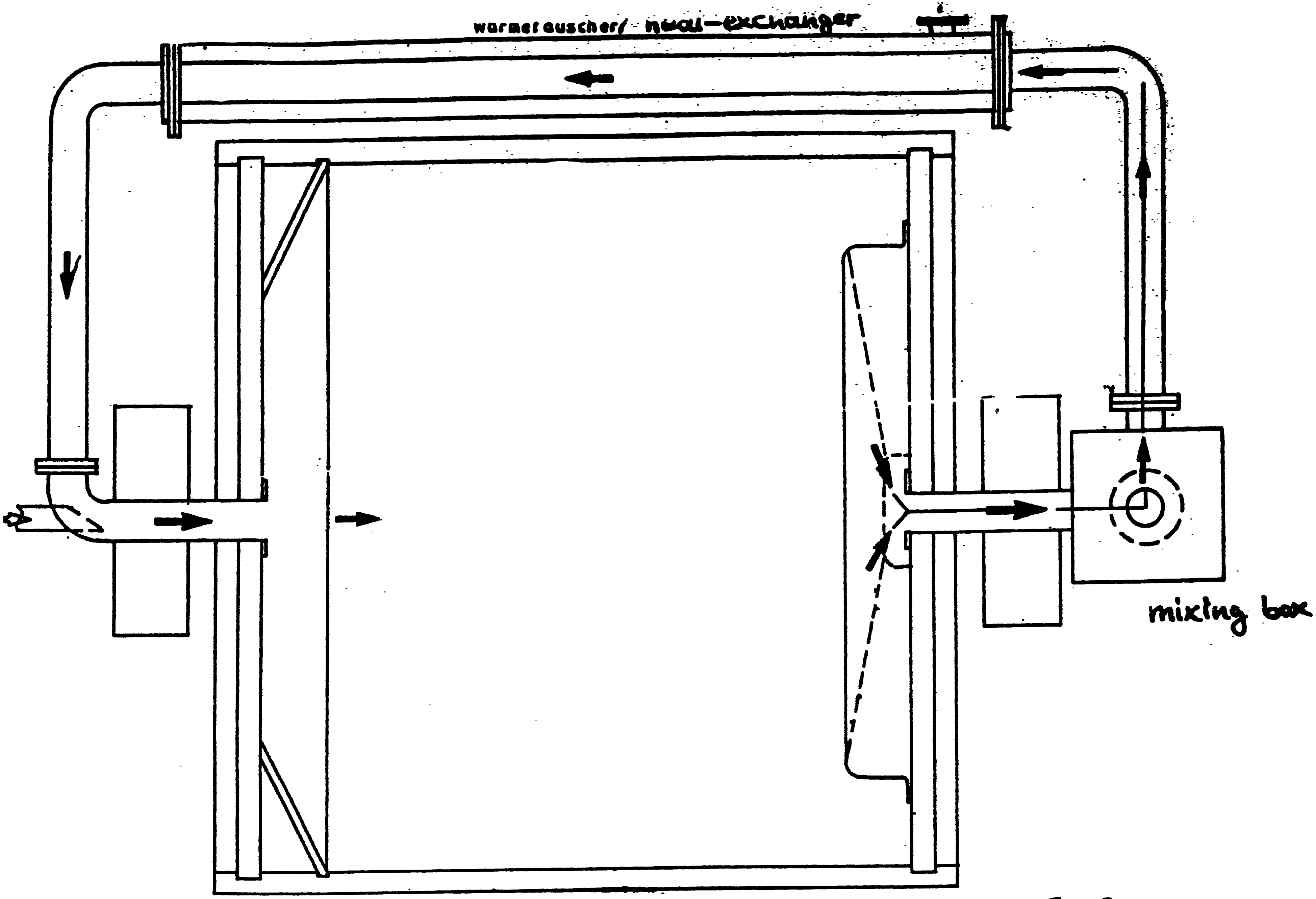


Fig. 8

Draufsicht (von Oben)

DOSEMAT

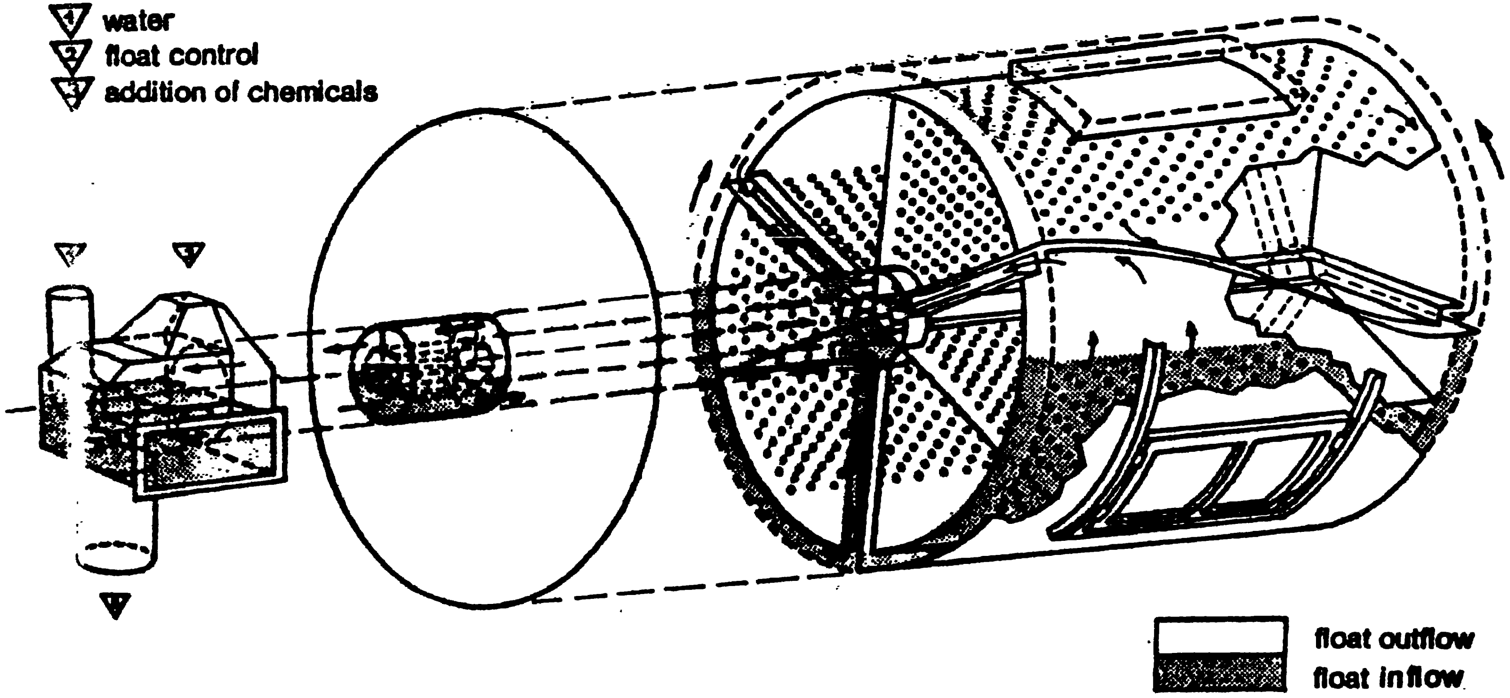


Fig. 9

MICROPROCESSOR CONTROLLED SYSTEMS FOR TANNERY WET OPERATIONS

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ABSTRACT

Microprocessor based process control systems are being increasingly used in tannery wet operations for better control, operation flexibility and energy/chemical savings. This paper highlights the state of art in microprocessor control systems with reference to wet operations like tanning. Future potential for their applications in newer areas is also examined.

* * *

The development of microprocessor based process control technologies has made significant impact on the automatic control of chemical, mechanical, electrical, metallurgical and allied process plants. There has recently been an emphasis in the leather industry to reorient the process operations in tanneries to implement some of the new process control strategies based on microprocessor systems. They include beam house processing, pretanning, tanning and post tanning operations and finishing techniques. the technical objectives behind the reorientation process include accurate process parameter control, operation flexibility and reliability, energy/chemical savings and rationalization of material handling. The present article highlights the strategies, hardware needs and typical application areas for microprocessor controlled systems in tannery wet operations. Particular attention is paid to the tanning operation wherein the benefits of automation are most evident.

APPLICATION AREAS IN TANNERY WET OPERATIONS

Commercially tanning is carried out by contacting hides/skins with a finite amount of tan liquor. It is a dynamic process in which the hide pH and possibly the basicity of the mineral tannage undergo continuous changes. A process control engineer should know that leather of acceptable quality results from this unsteady state process though with poor reproducibility. The latter aspect is significant for introduction of process control system in the tanneries.

For the application of microprocessor based control systems, the following steps in the tanning process are of vital importance under Indian context:

i) Stripping (40 - 9/10 - 90)
ii) Water washing (40 - VL - 25)
iii) Bleaching (40 - 3/4 - 60)
iv) Water washing (40 - VL - 45)
v) Chrome tanning and basificaation (40 - 3/4 - 360)
vi & vii) Water washing (50 - VL - 80)
viii) Neutralisation (50 - 5/6 - 165)
ix) Water Washing (50 - VL - 40)
x) Retanning, dyeing, fat liquoring etc. (60 - 6/7 - 210)
xi) Water washing (30 - VL - 40)

Note : VL - Variable

The data presented in the parantheses are typical temperature (in ^{o}C), pH and duration (in minutes) of each operation. A variety of chemicals are employed for the operations. They include sodium bicarbonate, borax, sodium sulphite, degreasing and bleaching agents, oxalic acid, basic chromium sulphate, retanning agents, a range of fat liquors and dyes, formic acid and other additives. Fig. 1 shows the operations plotted on a time chart for three process streams operating in parallel. The actual working schedule in many tanneries is far more complex. The following operations need precise control and monitoring:

1. Temperatue control and logging
2. pH control and logging
3. Volume/weight control of chemicals and water
4. Level control in chemical and water tanks
5. Flow regulation of chemicals
6. Drum speed and direction control
7. Float recycles
8. Draining of treated tan liquors
9. Time control for various operations
10. Indication for manual intervention
11. Preparation of protocols for process recipes

STRATEGIES FOR MICRO PROCESSOR BASED CONTROL SYSTEMS

While evolving control strategies, collection of various electronic and pneumatic analog inputs, integration of the computer output into the control system and simplicity of back up schemes are important factors to be given due considerations in tannery systems. Supervisory control strategy based on microprocessor adjustment of the instrument controller set point and instrument control of the manipulating variable is the most suited since lower demand is placed on the microprocessor system. A limitation of this strategy is that the amount of microprocessor backup has to be confined to the necessary schemes required by the tannery engineer. The other advantage is that the process signals are simultaneously fed to the computer and other analog controllers; the former's failure does not cause immediate process upset. The functional control of a micro processor control system is shown in Fig. 2.

In a typical wet section of a tannery, the most commonly encountered process analog signals are temperature, level, flow, volume and pH. They must be conditioned i.e. linearized, magnified, filtered and converted to digital mode before being picked up by the microprocessor. A multiplexer handles several analog signals in a serial manner like a selector switch. Demultiplexing is the opposite of multiplexing. Functions of the microprocessor include signal conditioning, data conversion, man-machine interface and system communication. The functions of the man-machine interface is to display the scanned data on VDU screen to enable the plant operator to enter requests to microprocessor for control.

IMPORTANT CASES OF MICROPROCESSOR CONTROLLED WET OPERATIONS

Controlled Water Addition System:

Tannery wet section requires hot and cold water in large quantities. Approximately, 600 Kl are required for aprocessing of 7000 skins for the operations listed in the earlier section.microprocessor controlled system can automatically deliver a given quantity of water to a preselected drum at a preset temperature and time. A general feature of the water addition system in a tannery wet section is the large, unscheduled and many times overlapping demand for steam (Fig. 3). Table 1 shows the various options available to generate hot water and their relative advantages and disadvantages. Figures 4 and 5 provide a schematic presentation of immersed tube heaters and the types of heatexchanger systems. A batch of hot water storage equipped with a combination of direct steam sparging and pump around heat exchanger systems is a typical example of a two phase heating set up with a provision for steam cushioning. Fig. 6 shows the details.

Supply of water at desired temperature to various drums can be effected through a water mixing valve/battery. The arrangement consists of hot and cold water feeder lines, a three way mixing and proportionating valve, water meter with impulse transmitter, temperature controller, exit lines with mixed water and other control accessories. Fig. 7 shows a typical system provided with hot water recirculation facility for achieving temperature stability of the water streams before they enter the drums and for the recuperation of the unused mixed water. The microprocessor can perform multiple functions in this case viz.,

1. Automatic water mixing and temperature stabilization
2. Directing the mixed water to the appropriate drums
3. Selection and volume metering of water
4. Selection and rigorous control of mixed water temperature and
5. Programming and printing out of water addition schedule

Implementation of Micro Processor Controlled Water Addition (MCWA) System requires extensive piping network. Fig.8 shows a typical piping layout. Package MCWA systems are available in international market. Typical specifications of such systems are:

1. Operating pressures : 2-4 kg/cm^2
2. Operating Temperature : 30-70°C (± 1°C accuracy)
3. Mixed water supply rate : 400-1200 lit/min
4. Number of drums to be handled by a single battery : 6-8
5. Number of pre-selected mixed water temperatures which can be programmed : 4-6

Controlled Chemical Additions Systems

Most of the chemicals employed for the tanning process are in liquid form and accuracy of their measurement is of importance in achieving consistent quality of leather from batch to batch. A Microprocessor Controlled Chemical Addition (MCCA) system has to fulfil following process needs:

i. Feeding of chemicals or their formulations from the storage tank farm.

ii. Automatic dosing of chemical volumes into the chemical premixing tank.

iii. Transfer of mixed chemicals to the prescribed drum.

iv. Memory storage of chemical quantities according to batch weight.

v. Print out of the dosings along with time schedules.

MCCA systems are generally based on load cells with electric probes. The other accessories are level controls for main chemical tanks, automatically controlled dosage valves for transfer of mixed chemicals, electronically controlled agitator system with time adjustment for mixing vessel and automatic failsafe devices including high level alarms and interlocks for pumps protection against running without liquids and overload. **Fig.9** shows a typical MCCA system connected to drums in a tannery. To accommodate manual addition of powders and small quantities of formulated chemical, intermediate chemical tanks can be incorporated. This arrangement will not upset MCCA system functioning. MCCA units can also be remote controlled with a computer system.

Integrated water and chemical addition systems

MCWA and MCCA systems can be integrated to facilitate automatic addition of water and chemicals at any desired temperatre and dosage. Piping network for water and chemical transportation can suitably be rationalized. **Fig. 10** shows a typicl integrated MC-CA/WA system.

One of the important application of MC-CA/WA systems is in multistage tanning operation (MTO). Our investigations on laboratory and bench scale levels, have shown that MTO can lead to high chrome uptake without any sacrifice of the leather quality. Further investigations are in progress to establish the commercial viability. In the present Indian context, batch simulation of multistage countercurrent operation looks to possess greatest potential at commercial level. Batch simulation of a countecurrent cascade is extensively practiced in metallurgcal, vegetable tannin and oil industries and it should not be difficult to introduce this concept in leather processing.

If it is to be practiced in chrome tanning process, untanned hides/skins have to be brought in contactwith the weakest chrome solution and the fresh chrome tan liquor has to contact the hides/skins which have received maximum chrome. In order to avoid physical movement of hides and skins from one drum to another, the arrangement shown in **Fig.11** is suggested for a three stage contact. The hides and skins are charged into a particular drum at a given time and are discharged from the same drum after receiving necessary tan liquor contacts in a counter current fashion. With the help of a Microprocessor Controlled Pumping System (MCPS), the liquor transfers can be automated from one drum to another to simulate the counter current multistage contact. The following are the basic features of a three stage arrangement.

i. Liquid transfer from one drum to another is clockwise.

ii. Loading/unloading of hides/skins is in anticlock direction.

iii. Each pump discharges fully treated (effluent) tan liquor from its parent drum and charge the fresh tan liquor to the next recipient drum once in three contacts in a particular cycle. During rest of the contacts, it merely transfers tan liquor from its parent drum to the next drum.

iv. Pump actions are controlled by timers linked with the mcroprocessor system

The limitations of batch simulation multistage contact pocesses are (1) they are not suited to tanneries which employ multiple process receipes to produce different types of leathers and (2). they have to undergo certain number of cyclic operations before attaining a state of steadiness. They are however, most suitable for tanneries engaged in large scale manufacture of certain types of leathers.

PROCESS CONTROL IN DRUM OPERATION

Given the pressing ecological demands and the urgent need to save on chemicals, it has become imperative to control the drum operations more precisely than hitherto practiced. The following areas require attention:

i. Drum function control
ii. Recycling of tan liquor
iii. pH control

Drum speed, direction of rotation and positioning can be controlled by electronic instrumentation. It is possible to have four adjustable speeds (forward and backward), automatic change of direction of rotation with the help of timers and a magnetic limit switch for the proper drum positioning with the draining valve at the lowest position. A safety interlock system can also be provided to the drum. Pneumatically controlled drawing and recycling valves can be incorporated to control the tan liquor recycle and discharge. A centrifugal recycling pump can be incorporated with necessary motor speed control for adjustment of recycle rate.

Instrumentation for pH measurement and control is among the most widely used process measurement devices in chemical industry. Rugged electrode systems and high sensitive electronic circuits are commercially available for application in tannery drums. The primary detecting element in pH measurement is the glass electrode. A potential is developed at the pH sensitive glass membrane due to differences in hydrogen ion activity in the sample and a standard solution contained within the electrode. This potential measured relative to the potential of the reference electrode gives a voltage which is expressed as pH. A complete pH measuring and recording device with alarm limits, consisting of two signal contacts to set the range within the desired pH, value can be incorporated as a part of drum operation control instrumentation.

Fig. 12 shows the typical control instruments for a drum monitored by a microprocessor. The advantages of providing such control systems are:

i. Control and pinpoint the time at which the process is completed
ii. More production cycles per day
iii. Instant mixing of chemicals with the float
iv. Precise control of process parameters like temperature and pH
v. Consistent quality of the leather
vi. Quicker draining and washing
vii. Recovery and reuse of expended float
viii. Better solid-liquid contact through the manipulation of drum rotation and its direction

CONCLUSION

By incorporating appropriate process control instrumentation, it is possible to introduce new processing methods and to reorganise the process sequences or chemical formulations in the tanning operations. The need for control instrumentation in the leather processing sector arises not only to achieve technical excellence but also to gain economic and financial advantages in the highly competitive world of leather.

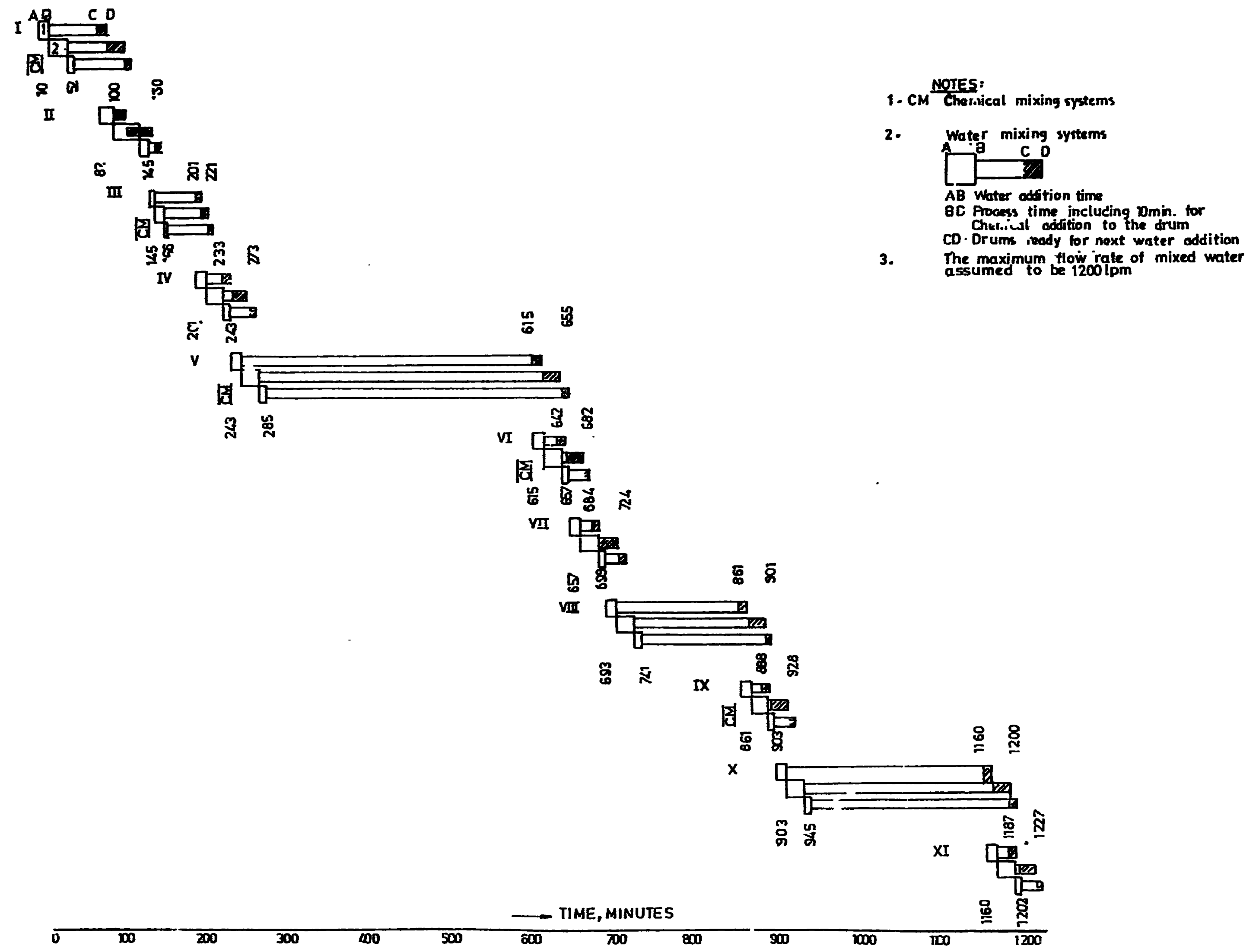
ACKNOWLEDGEMENT

The author expresses his gratitude to Dr R B Mitra, Director, Central Leather Research Institute for his encouragement to publish this work. His thanks are due to Shri M R Sridharan for the steam and other calculations and Dr P R Patnaik, Shri H Purushotham and their colleagues in Chemical Engineering Division for their useful suggestions. A word of appreciation to Shri K R Radhakrishnan for the careful typing of the manuscript and Messrs K Sesha Sai, L Subramanyam, P Pushpanathan and Mrs V Rajyalakshmi for preparing the drawings.

TABLE 1

OPTIONS FOR TANNERY WATER HEATING

HEATED BATCH STORAGE SYSTEMS	ON LINE WATER HEATERS		
	Immersed tube heaters	Heat exchanger with a large heat output	Electrical heaters
- Sytesms too large - Helps in steam cushioning - Need automatic mixers * Steam-Cold water * Hot water-Cold water - Non conventional energy can be employed	- High heat transfer capacity - Turbulent flow inside tubes - Flue gases, fuel gases can be used - Need water storage facility - High grade control system required	- Response time very short (< 30 sec) - High grade control system required	- High power consumption - More useful as standby



NOTES:

1 - CM Chemical mixing systems

2 - Water mixing systems

AB Water addition time

BC Process time including 10min. for Chemical addition to the drum

CD - Drums ready for next water addition

3. The maximum flow rate of mixed water assumed to be 1200 lpm

Fig.1 TYPICAL TIME CHART OF TANNING PROCESS

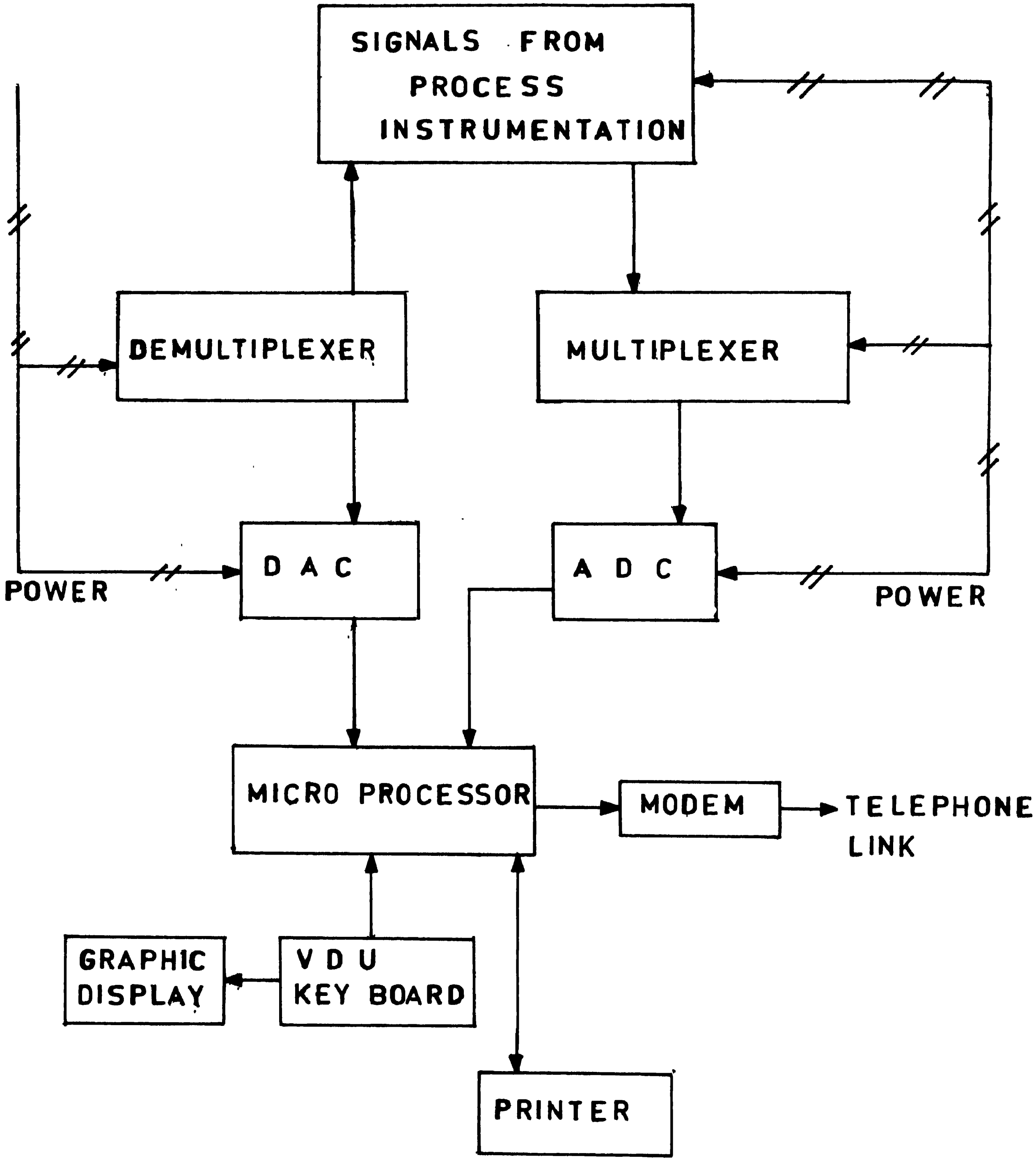


FIG. 2: FUNCTIONAL DIAGRAM OF A MICRO-PROCESSOR CONTROLLED SYSTEM.

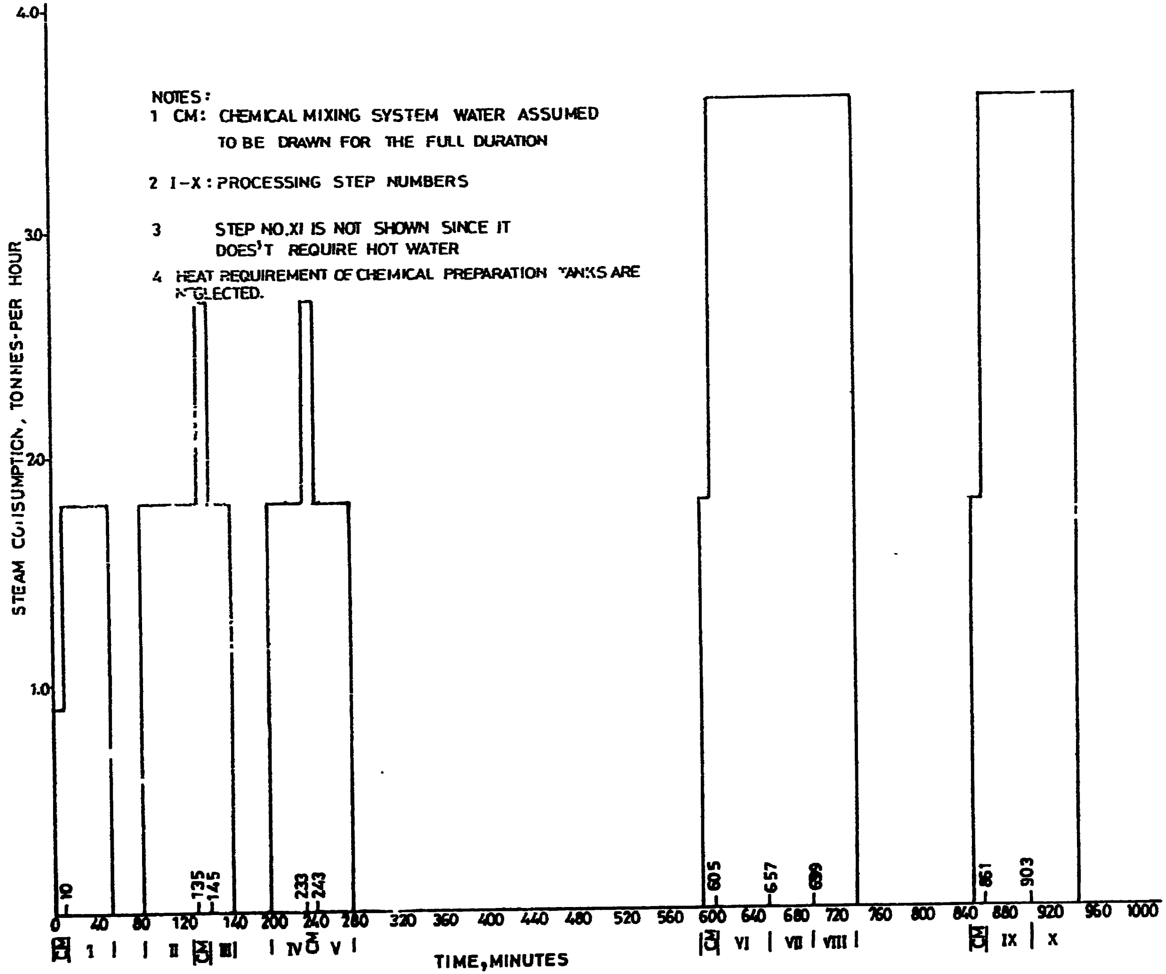


Fig.3 TYPICAL STEAM CONSUMPTION PATTERN IN MCWA SYSTEM

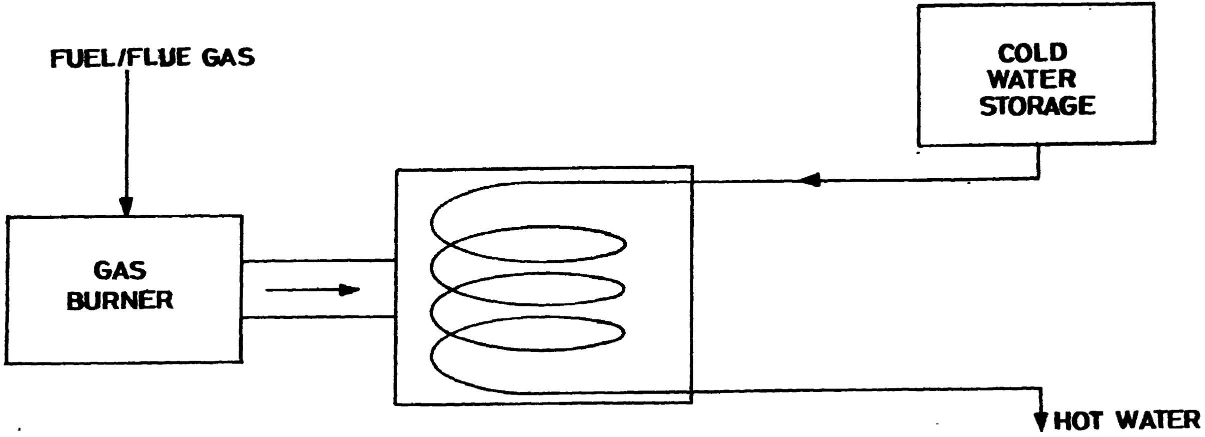
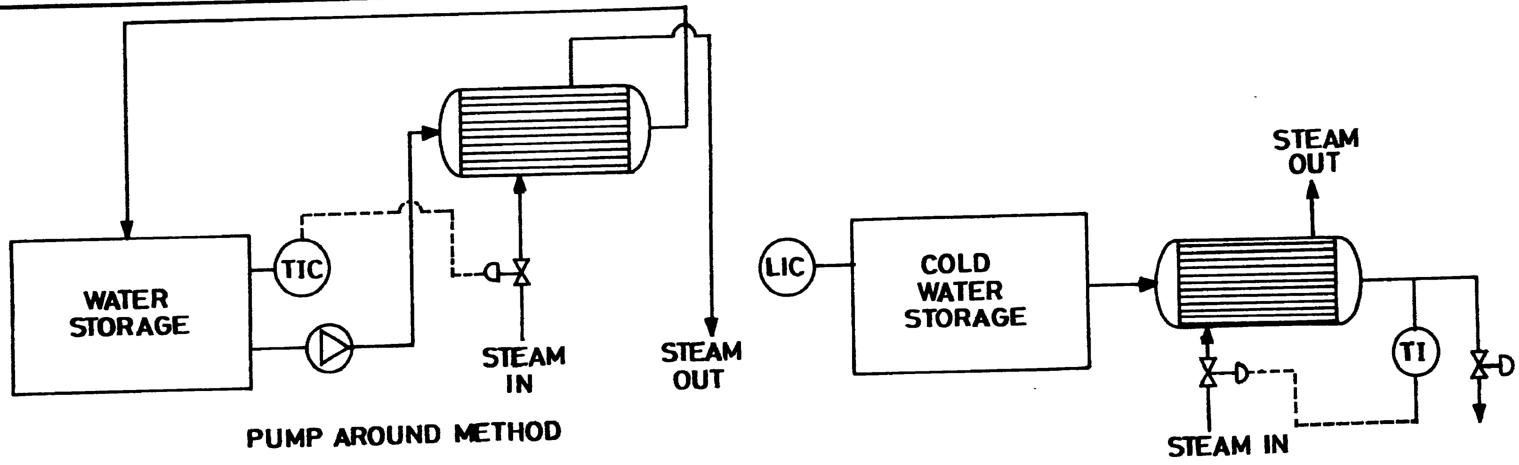


FIG.4 IMMERSED TUBE HEATERS



PUMP AROUND METHOD

ONCE THROUGH PASSAGE METHOD
(Large Heat Output)

FIG.5 HEAT EXCHANGER SYSTEMS

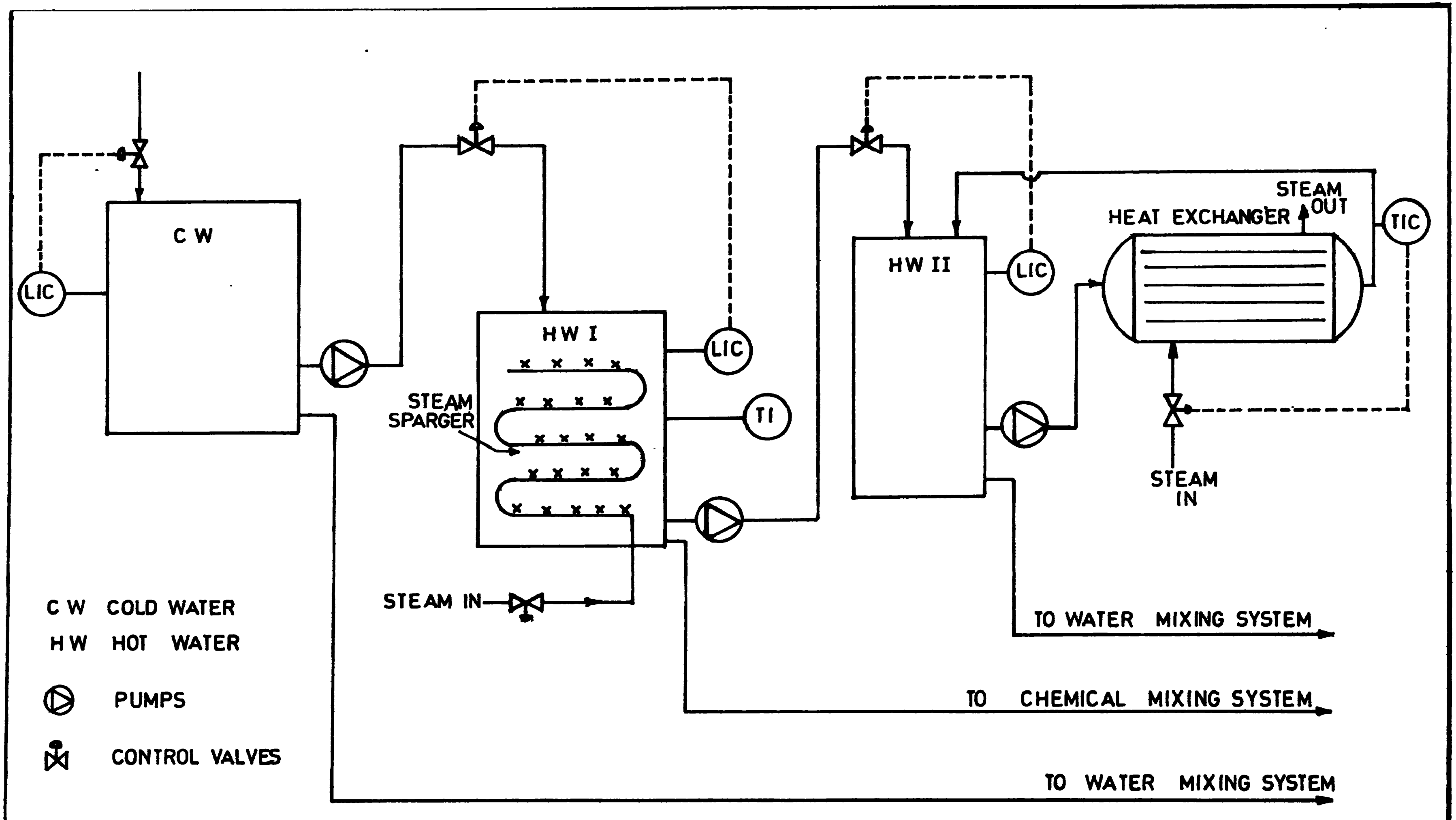


Fig.6 A COMBINATION HOT WATER SYSTEM

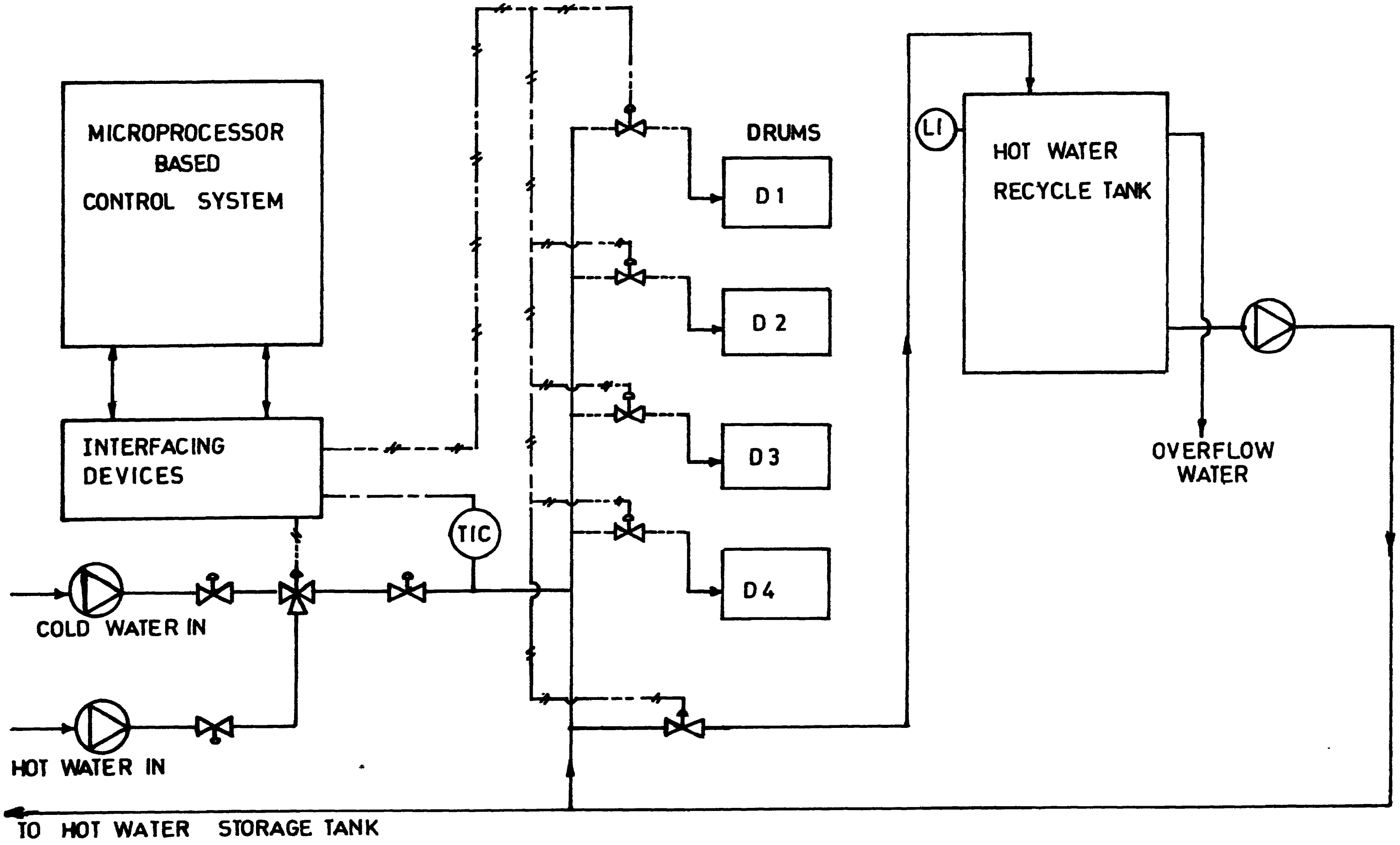
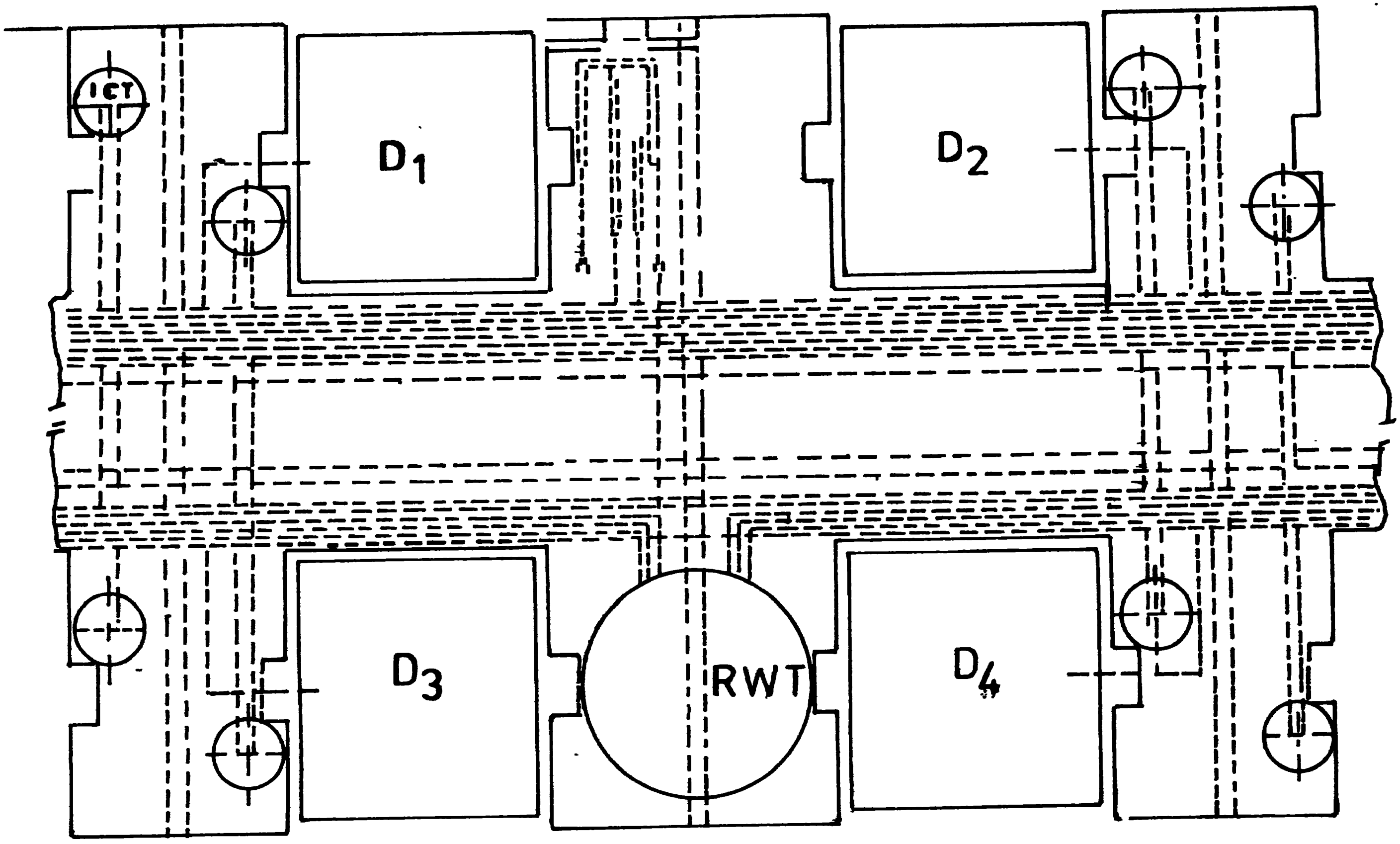


Fig.7. MICROPROCESSOR CONTROLLED WATER MIXING AND SUPPLY SYSTEM



ICT : INTERMEDIATE CHEMICAL TANKS

RWT : RECIRCULATION WATER TANK

D_1–D_4 : DRUMS

FIG. 8: PROCESS PIPING NETWORK FOR MCWA

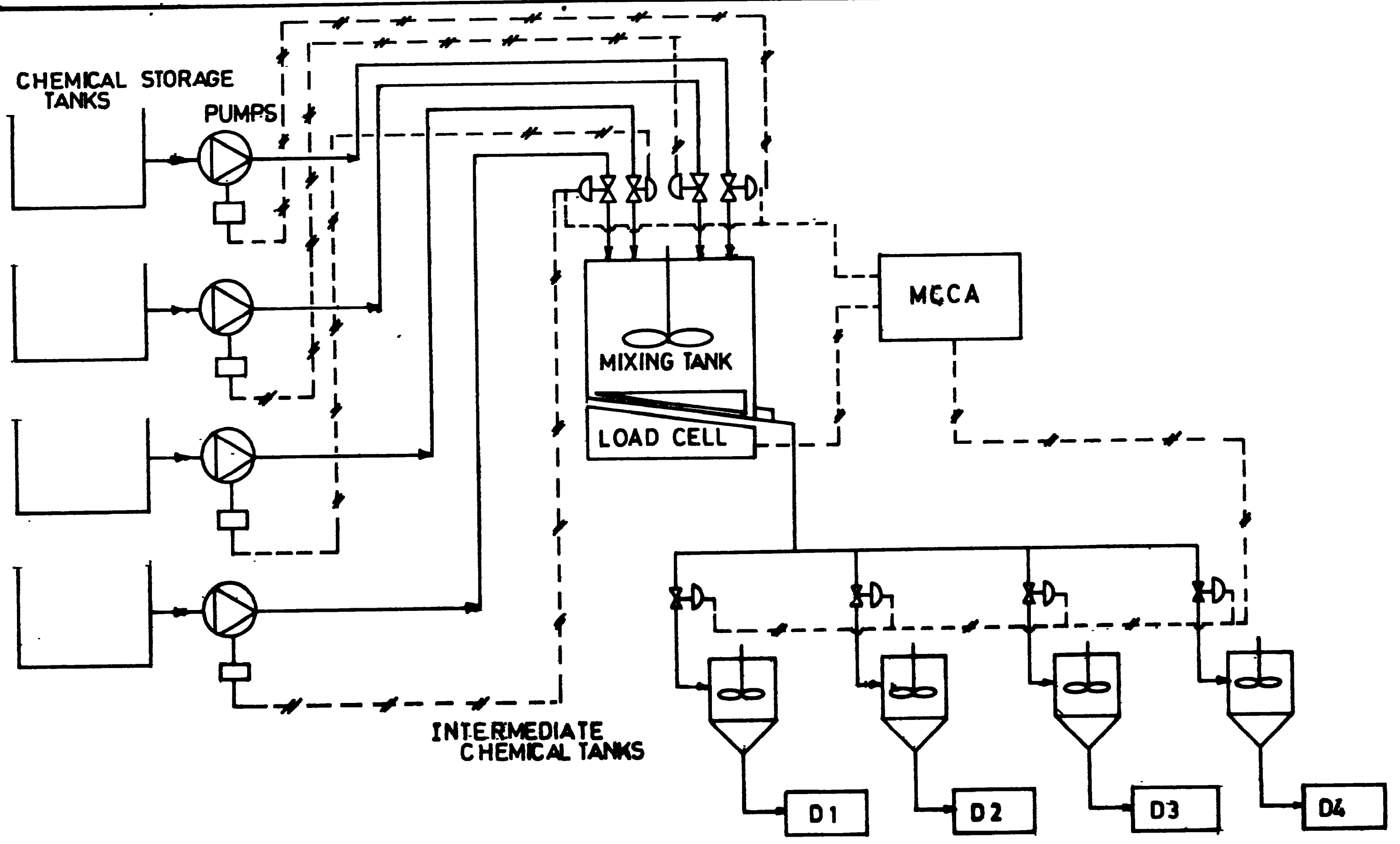


FIG.9 MICROPROCESSOR CONTROLLED CHEMICAL ADDITION SYSTEM

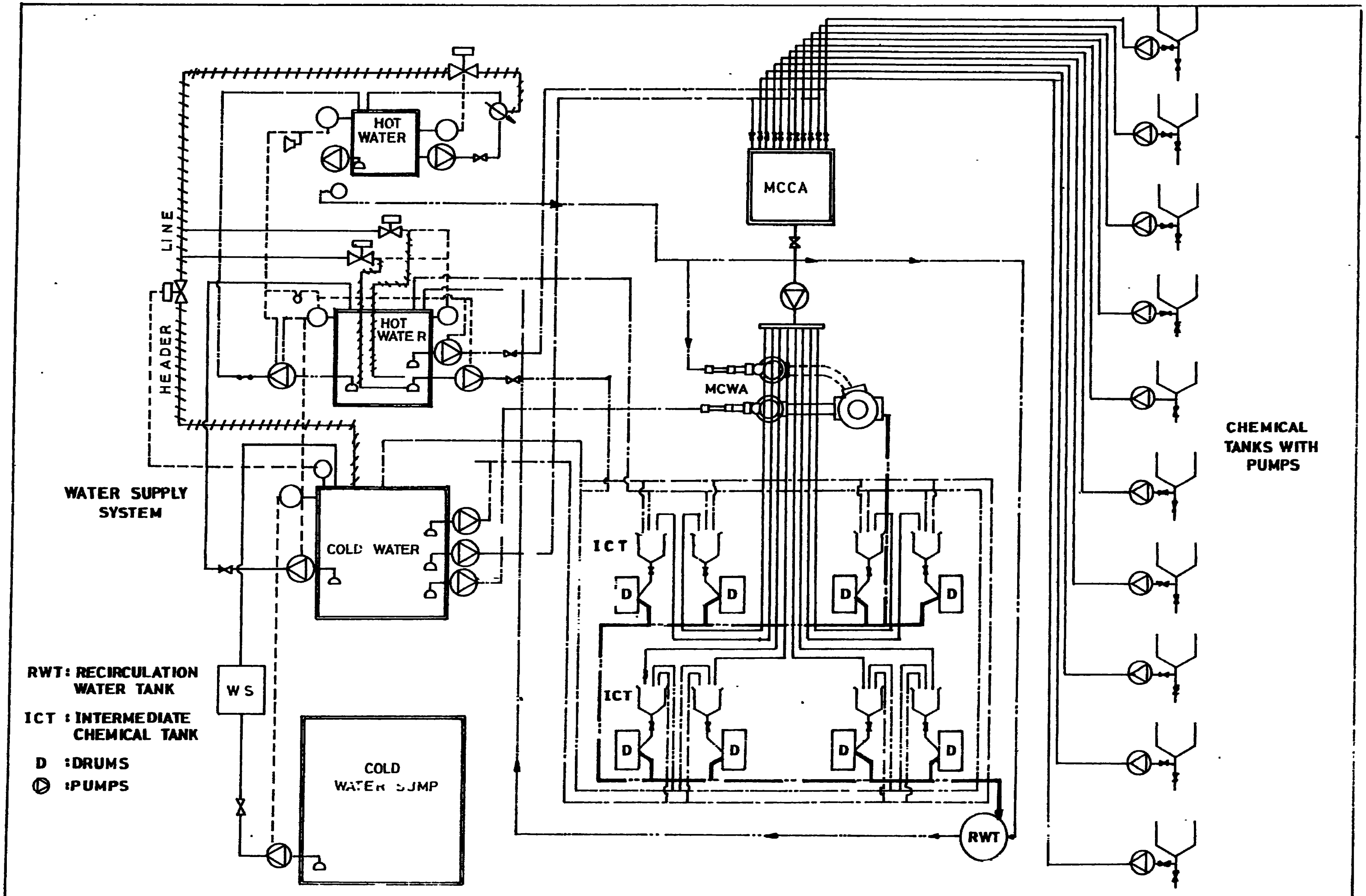
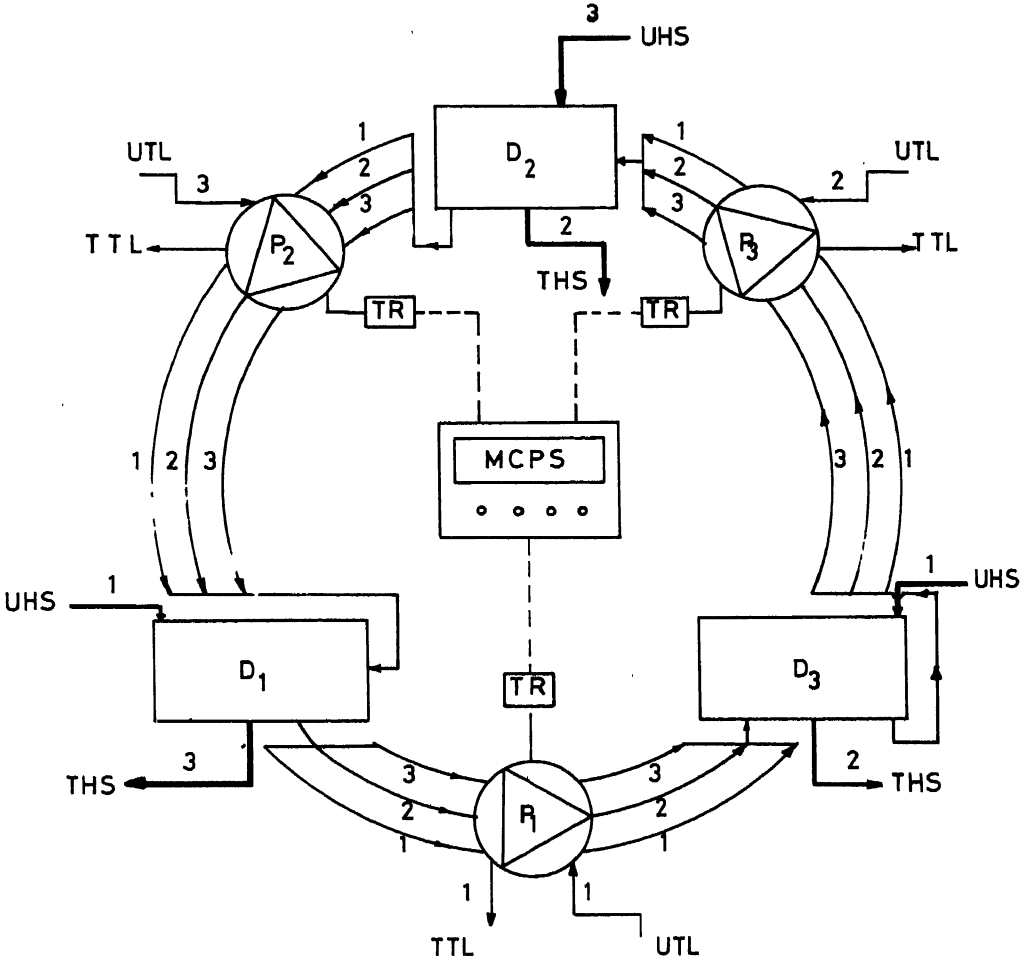
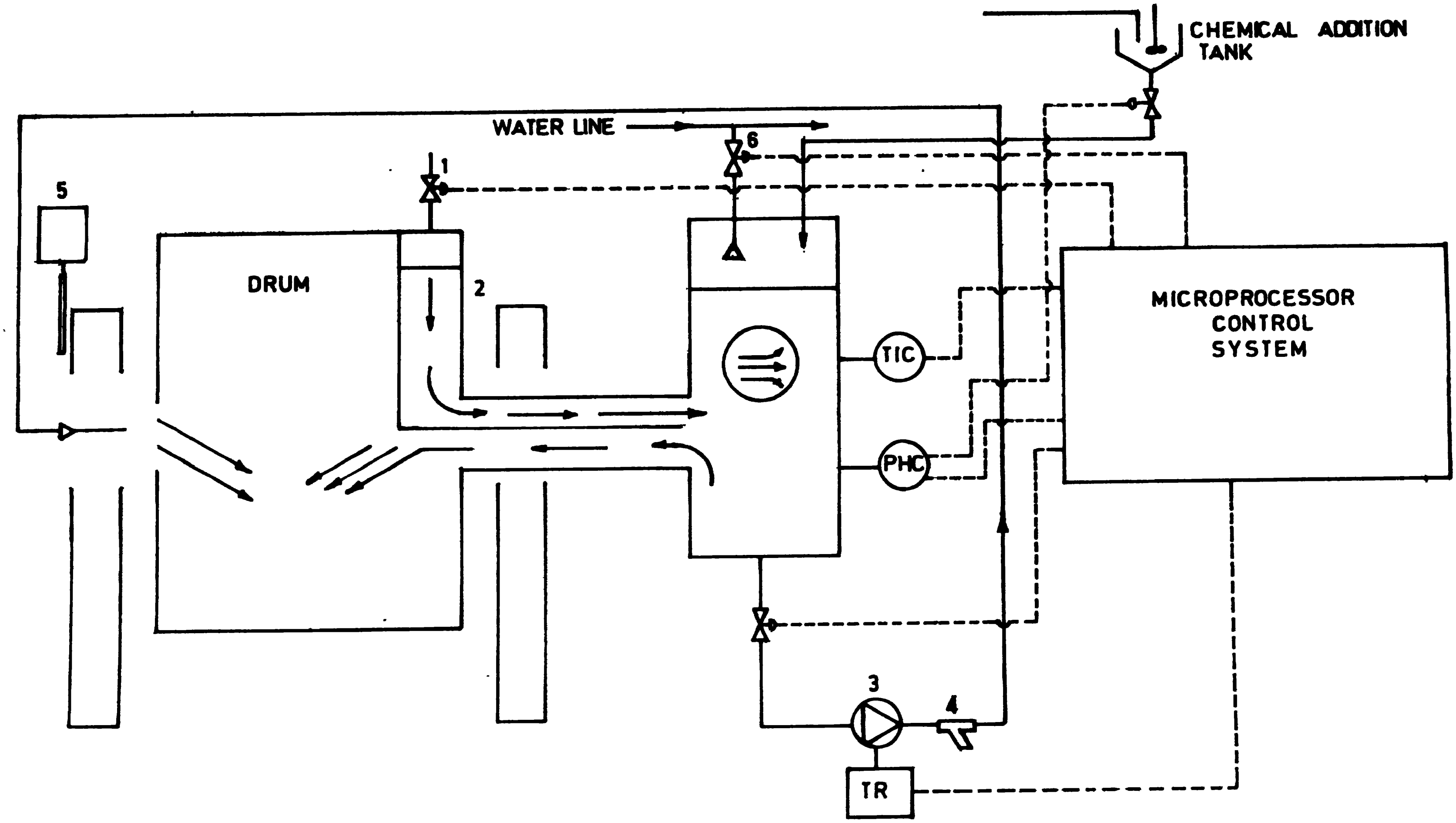


Fig.10 INTEGRATED MC-CA/WA SYSTEM FOR A TANNERY



TR - TRANSMITTER
MCPS - MICROPROSSOR CONTROLLED PUMPING SYSTEM
UHS - UNTREATED HIDES/SKINS
THS - TREATED HIDES/SKINS
UTL - UNTREATED TAN LIQUOR
TTL - TREATED TAN LIQUOR

FIG 11 - MICRO - PROCESSOR CONTROLLED PUMPING SYSTEM FOR MULTI STAGE TANNING



1. PNEUMATICALLY CONTROLLED WASH AND DRAIN VALVE.
2. TAN LIQUOR RECYLING DEVICE BUILT INTO THE DRUM.
3. RECYCLING PUMP.
4. LINE FILTER FOR SUSPENDED SOLIDS.
5. MAGNETIC LIMIT SWITCH
6. RINSING VALVE.

Fig.12. MICROPROCESSOR CONTROLLED DRUM OPERATIONS

BIOTECHNOLOGIES FOR BEAM HOUSE OPERATIONS

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With an astonishing pace of development in the last few years, almost unmatched in any other contemporary field of applied technology, biotechnology holds enormous promise for helping to fulfil some of humanity's most fundamental needs - from increasing food and energy supplies to improving health care and environmental control. The term biotechnologies relatively new although one could already have used it when cabbage was made into sauerkraut for the first time in Germany or when biology was harnessed for years to produce wines, beers, vinegar, foods, solvents, ethanol as an energy source and drugs like pencillin. What is new about the new biotechnologies the style of approach and the methodologies now available. Astoundingly simple natural processes are gaining importance once more in our age. This wonder branch of science, biotechnology is poised to revolutionise the leather industry and in this paer, I shall discuss the possibilities of biotechnology in the leather industry.

The principal leather making protein collagen exists in hides & skins in association with various substances such as keratin, elastin, albumins, globulins, nucoids, lipids, carbohydrates and mineral salts. During leather manufacture, the non-collagenous constituents are removed partially or completely in the various beamhouse operations namely soaking, dehairing, liming, deliming, bating and pickling and the extent of removal of these constituents decides the characteristics of the final leather. The use of biological processes involving either whole cells or enzymes can contribute to solutions for these problems in a number of ways. Enzymes have been used by the tanners for several years now. The ancient American Indians took advantage of the naturally occuring enzymes to cause hair loosening. This is the sweating process. The use of dog dung and chicken manure infusions as a bate has infact been attributed to the enzymes elaborated by bacteria growing in them. The Azazym process developed by Rohm was the first enzymatic unhairing process reported. It was adopted for commercial exploitation for sometime but was later replaced by less expensive chemical methods. Biotechnology has made the microbe, the work horse of the modern world. According to geneticists, it is an era of 'bugs' as the bacterial and various lowly organisms have been tutored for industrial purposes to produce medicines, enzymes and human proteins and to break toxic pollutants in the environment. Microbial enzymes are not subject to any of the production or supply limitations of plant and animal enzymes. The diversity of enzymes available from microrganisms is almost without limit. The recent developments in large scale production and isolation procedures of enzymes from microorganisms have not only assured a potentially unlimited supply but also made possible the isolation of new enzyme systems which could not be obtained from plant and animal sources. One aim of enzyme technology is to use this expertise to supply the large quantities of enzymes required by the food, pharmaceutical, textile and leather industries to improve the quality and economic supply of their products.

The important areas wherein enzymes can find application in tannery operations include soaking, unhairing, bating, degreasing, offal treatment and effluent treatment.

Soaking

In the soaking stage, the enzymes make it possible to shorten soaking time considerably. The objective of soaking is to rehydrate the protein which has been dehydrated during the process of curing. During curing, the soluble proteins like albumins and globulins which are associated with collagen gets coagulated and cement the fibrous protein. These should be removed in the soaking operations. In the conventional soaking, using wetting agents and preservatives it takes long time. Use of enzymatic agents have been advocated to accelrate the process as it will be advantageous to avoid prolonged soaking. Enzymes also help in loosening of the scud and initiation of the opening of the fibre structure. Soaking enzymes used from various sources are listed in Table 1.

With the use of more rapid processing methods in todays tanneries, the use of enzymes in the soak for more rapid wetting may be a definite advantage depending on the end product desired. The type of enzyme selected should have a broad spectrum action in order to obtain both the solubilisation and removal of the inter fibrillar proteins and also easier rehydration of the skin.

Degreasing

This is a potential area for enzymatic process. Although some of the beam house operations like liming removes the natural grease that is present in pelt, there are certain raw material which contains a very high proportion of fat. Lipases have been indicated for their use as degreasing agents. They catalyse the breakdown of fats and can be from bacterial, fungal or plant sources. The advantages of using lipases for degreasing are:

(1) Elimination of solvents
(2) Reduction in the use of surfactants
(3) Possible recovery of valuable by-product

However lipases do not remove all types of fats and add to the cost of the process.

Enzymatic processing of hides to facilitate grease removal requires more study.

Offal treatment

Offal treatment by enzymes appear to have potential as an economical method of waste treatment to generate byproducts which could be useful to the chemical industry. As far as solid residues are concerned such as trimmings and fleshings, the use of enzymatic preparations allows recovery of fats and proteins that is currently being achieved by the use of steam or by acid or alkaline hydrolysis. The chromed residues can also be broken down by enzymes so as to recover the chrome and nitrogenous protein substances. A.fumigatus, P.lapidosum and Pseudomonas Sp. were found to hydrolyse chrome shavings and a species of Actinomyces could hydrolyse vegetable shavings. In this way by-products with saleable value could be generated.

Unhairing

Technological developments are assessed today not only for what they do for man but also for what they do to man. For many years the greatest problem besetting the tanning industry has been the pollution of the environment. The conventional lime and sulfide process used for unhairing of hides and skins is one of the major causes of the high COD and BOD of a tanneryeffluent. Lime produces sludge, high alkalinity and sodium sulfide is toxic and has an obnoxious odour. Any technological process that makes it possible to reduce the cause of pollution or even to get rid of pollution would therefore be an enormous advantage. Enzyme based technologies offer viable alternatives, although standardisation of processes for the manufacture of enzymic unhairing products have so far been difficult.

Several researchers all over the world have clearly emphasised that proteolytic enzymes are a sound alternative to the lime and sulphide process. However enzymatic unhairing has certain limitations. They are:

(1) The cost of enzymes are prohibitive and hence do not provide an incentive for the tanners to adopt this process

(2) Enzymes are biological catalysts and hence careful control and monitoring are necessary for their application.

(3) Modification of subsequent processes may be necessary to get leathers with the desired properties.

The microbial enzymes so far used as depilants are listed in Table 2.

The strides made in biotechnology are readily seen in the dramatic progress in enzyme technology. Scores of enzymes made by microbes have gained commercial significance. Enzymes can be produced by two types of microbial fermentations.

(1) Submerged fermentation in deep tank stirred fermentors and

(2) Solid substrate fermentation

This refers to a system where the substrate is a solid and no free liquid is available. SSF has been practised by the people in the orient for the preparation of their traditional foods like Soy Sauce, miso, Tempeh etc. Even now in Japan these products are made only by SSF, although now the entire system is fully automated. After World War II, due to the very rapid developments in technology for submerged fementation, development of SSF was sidelined. But recently there is a renewed interest in SSF even in the Western world and several biotechnologists have reported the use of SSF for the production of various products.

The characteristics of SSF are:

1. Simplicity of growth media. Often wheat bran or rice bran moistened with salt solution is sufficient as a substrate for the production of the desired product.
2. Greater compactness of fermentor vessel due to the use of less water and higher substrate concentration.
3. Simplified procedure for inoculum build up
4. Simpler down stream processing
5. Less chance of bacterial contamination
6. Increased productivity
7. Comparitively better economics mainly due to the requirements of simpler plant, machineries and growth media.

Some of the demerits of SSF are that it is limited to those organisms that can grow and produce the desired product on a solid substrate. Control of pH and monitoring of growth is difficult. Due to the generation of metabolic heat, temperatures can exceed 50°C. Hence sufficient cooling should be provided to absorb the heat generated.

In CLRI efforts are being directed towards the development of mainly proteolytic enzyme systems for use as depilant and bate. Earlier it was indicated that cost was one of the main factors inhibiting the adoption of enzyme depilants on a large, commercial scale. It is known that SSF proves to be comparitively more economical than submerged fermentation for the production of various enzymes. Against this background, we have been recently focussing our attention on the development of a SSF system for production of proteolytic enzymes. For this purpose a number of strains were screened for their ability to produce extracellular proteases and a fungal strain belonging to the *Aspergillus* family was identified for its potential to produce large amounts of extracellular proteases. This strain has been identified to be an *Aspergillus flavus* strain and also shown to be non-toxicogenic. Some of the important properties of the enzyme can be seen in Table 3.

Various factors influencing the production of extracellular proteases under SSF conditions by *A. flavus* isolate have been optimised at bench scale. These include:-

1. Period of incubation (72 hours)
2. Temperature of incubation (30°C)
3. Moisture content (60%)
4. Type of wheat bran - coarse and fine varieties are equally effective
5. Addition of salts and trace elements
6. Pretreatment Time (45 min.)

Scaling up of production was carried out under controlled conditions of humidity and temperature in the Koji Room of the Fermentation Technology and Bioengineering Dept. of CFTRI, Mysore.

Simultaneous to studies on the production of the enzyme, efforts have been made to establish the use of the enzyme as a depilant for dehairing of hides and skins in the experimental tannery of CLRI. A large number of trials have been carried out with goat skins. The results have been encouraging and we are currently engaged in modifications of existing processes to obtain leathers with the desired properties. The use of this enzyme as an alkaline bate after dilution has been established after trials in the experimental tannery of CLRI.

For large scale production of enzymes,strain improvement and the evaluation of the optimal fermentation method(medium composition,pH,temperature and aeration rate) are crucial. Strain improvement for increased yields is an ongoing task for the industrial microbiologist and to achieve this, mutation is still a more practical approach, but there is very little possible in the way of directed alteration. Genetic engineering has a key role in the large scale manufacture of industrial enzymes and the economically attractive technique can evolve new breed of microbes that can yield five to ten times more of enzymes than the naturally occurring bugs. This new biotechnology uses knowledge about the interior of cells to direct and manipulate the products they make. These possibilities are nowbeing examined in our laboratory.

One should remember at this stage that basically enzymes are biological molecules, proteins - that can alter the rate of particular chemical reactions but remain unchanged once the reactions are complete. They are specific in action and are required in small quantities. An enzyme keeps its precise shape on which its activity depends, only in certain conditions and by varying the temperature and pH, enzymes can be switched on or off or even totally destroyed. One should not expect therefore an enzyme to behave identically at the summer temperature of 40°C and the very low winter temperature in many parts of our country. It is essential therefore to have a realistic understanding of the problems and potentials associated with this biological process and try to assess the changes needed in our tannery set up to bring these new technologies into practice.

Effluent Treatment

Biological systems can contribute significantly in the detoxification of tannery effluents. Their possible modes of application is summarised in Table 4.

Value added collagenous products from waste materials

Eventhough collagen biotechnology has dawned thousands of years ago when man first made leather from hides and glue from bone, its application in various other areas was realised only in recent years. Collagen in almost all physical state has been used in medicine or pharmacology. As a biomaterial, collagen has an advantage over synthetic polymers, since it is derived from living organisms. Many of the clinical needs for biomaterials could be well served by this natural material. To those primarily interested in medicine, collagen has a tremendous appeal because of its widespread occurrence and its importance in many pathological processes. In leather industry large amounts of collagen from tissues are wasted. The preparation of collagen for use as a biomaterial can be broadly classified into two major approaches. In one approach, biological structures are treated in some way to remove non-collagenous materials and to strengthen the remaining collagen. Existing structure and probably many of the intermolecular crosslinkages are retained. In the second approach, collagen is first solubilised and purified through the use of enzymes and then attempts are made to reform and re-crosslink the material in the proper shape. The former approach has the advantage of exploiting normal, biological, three dimensional structure in a biomaterial, but has the disadvantage of having relatively fixed and predetermined configurations. The latter approach has the problem of reconstituting collagen material with appropriate strength, but offers a very broad potential in possible applications. The biomedical uses of collagen are going to be of very high value, eventhough relatively small tonnages of the total collagen are being used for this purpose now. The inferior part of the skin and other waste cuttings and trimmings can be used for making collagen based biomaterials without making serious inroads into the leather industry. The future holds a great promise to the collagen biotechnology. Utilisation of soluble collagen and its partial breakdown products will be the future attempts to make new products.Collagen can be used as a biomaterial for soft contact lens, drug delivery carrier, dialysis membrane, hemostatic agent, wound dressing or artificial skin, soft tissue augmentation, artificial blood vessels, ophthalmic uses for vitreous substitute, cell culture substratum and so on. Collagen can fetch added value upto 10,000 dollars per kilogram if it is used in certain biomedical and cosmetic areas.

Biotechnology may help change cattle scene and the quality of hides

For Indian leather industry, in particular, cow hides have been of very low grade, besides being smaller in size and thickness. This position can be improved only by breeding and mass multiplication of new and better strains of farm animals. The Indian livestock population according to a recent survey conducted by CLRI is around 440 million of which 200 million is cattle. The cattle figure is about one sixth of the world population. But the total milk production remains extremely poor. The major reason for the low milk yield is the low genetic potential of the majority of the Indian breeds, inadequacy of feed and fodder and prevalence of disease. In fact the stray cattle phenomenon is in part due to this. The multiple ovulation embryo transfer (MOET) technology practised in various parts of the world has great potential for the genetic improvement of indigenous cattle. In this technique low yielding cow varieties are used as foster or surrogate mothers to carry forth pregnancies effected in high milk yielding cows. The natural process of conception in animals is progressively changing to artificial inseminations but this procedure exploits only the genetic potential of the males of breeds selected for the purpose.

A cow gives one ovum in a menstural cycle. In her entire life span she may calve around 10 times. Scientists have found that by using hormones, they can stimulate production upto 10 ova in place of the normal single ovum in the cow. The super ovulated cow receives artificial insemination to development of corresponding number of embryos. After a week these embryos are flushed out and separated. These embroys develop into calves in the surrogate mothers. The breeding and mass multiplication of new and better strains of farm animals will greatly influence the quality of hides and skins and one can expect that the wide variations noticed in the quality of raw hides and skins today will disappear to a great extent as identical uniform strains of animals are produced in the future. It is to be expected that the hides and skins which will be available in the future will be much bigger than what we are getting today. Even the most imaginative person cannot forecast where we will be in 2000 A.D. The subject of my discussion is therefore burningly relevant. Let us therefore try to identify these new horizons in biotechnology and try to assess the changes needed to bring them closer. The biologists are making steady progress and possibilities of employing the new technologies are also increasing. One already speaks of a "bio-society", because we are gradually coming to realise how greatly bacteria,enzymes and genes can affect our lives.

TABLE 1

Microbial enzymes used for Soaking

Microorganisms	Types of enzyme	Reference
Aspergillus parasiticus	Proteolytic enzyme and carbohydrase	Grimm, 1966
A. flavus		
A. Oryzae		
Bacillus Subtilis		
A. awamori	Carbohydrase	Rokhvarger 1971
A. Oryzae	Carbohydrase	Tosher and Esanlenko, 1972

TABLE 2

Microbial enzyme used as depilant

Microorganisms	Types of	Reference
Bacillus Subtilis	Protease	Simoncini and Kubota, 1965 Simoncini et al,1967 Simoncini and Tessifore,1971
Bacillus Subtilis var *Bioticus*	Spitase	Kubota and Komaki, 1965
S. moderatus NRRL 3150	Protease	Chandrasekaran and Dhar,1985
A. flavus	Alkaline protease	Work going on at CLRI Biochemistry Lab at present

TABLE 3

Properties of the Extracellular Protease of A.FLAVUS

1) Inducible System

2) Active over a pH range of 7.0 to 10.0 showing two optimum peaks at pH 7.5 and pH 9.25

3) Inhibited by PMSF and EDTA

4) Optimum Temperature is 42°C

5) Can be stored at room temperature in a dry form for two months with a loss in activity of about 10%

6) Exhibits high caseinolytic activity

TABLE 4

Biotechnology in Effluent Treatment

1) Recycling of Immobilised Microbial Enzymes to hydrolyse the solid waste

2) Recycling of Immobilised whole cells to adsorb or detoxify the toxic metals of the effluent

3) Development of methane generating system by anaerobic organisms to reduce solid wastes

4) Biotransformation of toxic chemicals like chromium

5) Biodegradation of phenolic compound which is used as preservative

6) Biodegradation of dyes and other organic compounds to its simpler form

7) Development of bio-preservative to eliminate salt preservation

8) Biodegradation of waste hairs by keratinases .

NEW TECHNOLOGIES AVAILABLE FOR INPLANT PROCESS CONTROL IN TANNERIES

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SUMMARY

Modern production methods have forced tanneries to accept increasingly accurate control .methodology. Although process control techniques were slow to take root, they have become omnipresent in every stage of leather production. The most recent developments mainly concern the wet stage and its processing, sorting and mechanical operations (mainly splitting and shaving) with trimming, finishing and area measurement The new technologies applied to the various process stages are generally computerized and have provided far greater potential for control so that the tanner can now run his company efficiently.

INTRODUCTION

Savings in production time which were introduced several years ago, demand increasingly accurate control over the various constituent processes of the tanning industry.

Yet, evolution has infiltrated exceedingly slowly. Although the original drums date from the turn of the century, the first generation of drum control equipment reached the market only sixty years later and micro-computers were not introduced into tanneries until the eighties.

Meanwhile, evolution has left its mark on all the constituent technical processes and today computerized production management has become a reality. Moreover, competition between the industrialized countries has resulted in the introduction of new technologies into the various stages of leather production. Alongside which, the spread of computerization into the whole range of production equipment has been exceedingly fast.

1. WET STAGE PROCESSES

Even though programmed rotation of paddle vats and drums was the first stage in equipment mechanization, it has to be admitted that there have been remarkable environmental changes over the last twenty years or so.

The loading of drums from the raw hide stock is now controlled directly, either by strain gauges mounted on the drum or by a weighing system on the overhead conveyor. The data thus collected is essential downstream in the process. The strain gauges can also be used to detect the quantity of drained float. Both the volume and preset temperature of the water supply are fundamental programmable inputs. Originally, simple thermostats mounted in the reheating tanks seemed adequate; but today, such sophisticated systems as AQUAMIX by HUNI can programme 5 temperatures and 18 drums at flow rates of up to 1 200 litres per minute and with temperatures accurate to 1° C.

Automatic control of drain valves also plays a role in the complete automation of the process when the input of chemical products is considered. Even though control of the quantity of liquid reagents seems feasible, despite their agressivity, powdered products are a far more difficult problem. Yet, today, the introduction of highly efficient and inexpensive screw distributors with several different screw speeds to ensure rapid and accurate delivery has automated dosage.

Naturally enough, one of the most interesting developments in drum equipment is the quite recently presented recycling equipment, such as CYCLON by VALLERO and the ECOLOGIC drum by OLCINA.

In fact, these systems have several advantages, firstly the drum float can be removed and subjected to various operations such as reheating during dyeing to improve colour fixation. Moreover, the float can be drained and strained before it is returned to the drum. This operation permits the removal of hair prior to liming which avoids its hydrolisis and consequent organic pollution. This equipment has also proved very useful in bath monitoring since deliming operations can be controlled from the pickling or basification stage through the measurement of pH. Other applications, such as measuring the efficiency of washing by monitoring the resistivity parameters or the turbidity of the soaking float can be readily envisaged.

Moreover, it should be possible to route liquid through a cell in which a spectrophotometer connected to a microcomputer would monitor the correct chemical progress of retanning or dyeing.

Finally, drum removability from the float permits process parameters to be corrected through the addition of powdered products during treatment prior to repositioning the bath. Computerization completely automates all the functions associated with the drum and,by relieving the production controller of all repetitive and fastidious tasks, has become essential to overall process control. Production management programmes have become indispensable adjuncts, providing memorization facility of all production formulae. These can be divided into five main categories.

- Standard formulae, including chemical products which are not modified during use (standard articles),

- Basic formulae, consisting solely of descriptions of chemical products,

- Dye formulae, consisting solely of coloring agents.The multiple combinations of the two last-named groups, used solely by the dye house. allow retrieval of any formula greatly reducing memory load,

- Pre-mix formulae, for the production of (non-)coloured bases, used in the finish shop,

- Laboratory formulae, defining the formulae of the setting-up phase before conversion to one of the four groups listed above.

Using this formulation module, it is possible to add, cancel, modify or combine any formula(e).

In a different module, from base article codes or from formulae codes, the computer can directly calculate the work formula. If, during the production process, quantities of additional products have been used, the operator can modify each file called to the screen. This entails an automatic updating of cost prices involved and a file sheet is printed out.

A third module provides automatic stock control of chemicals together with the print-out of work programmes. The programme provides conventional functions of stock control (add, cancel product, control print-out, alert levels, prices and quantity consumed).

A fourth module in the programme permanently calculates the price of each formula as a function of the most recent price update of stocked products, even if the formula has been modified. Thus, available stock and products consumed are evaluated automatically through the weighted average price of stock updated by the computer.

Consequently, computer assisted stock management provides control of all elements involved in competitive production. By linking the control systems governing drum functions to the water and chemical product supply controls, it is possible to completely automate the wet shops.Even though the most complete systems are offered by HUNI (COMPUTAN), the following contribute to automation to a greater or lesser degree : DOSE (DOSELOG) VALLERO (CYCLON) OLCINA (LOGICA) CDP (COMPUDRUM) and CTC (SAGACE).

It has been proved that these various systems can provide savings of up to 8 % in chemical products, 20 % savings in water and a much better division of work by rationalizing the production flow (just in time).

2. SORTING OPERATIONS

During the production process, sorting operations associated with physical dimensional measurements (thickness, area) and with quality grading are essential. Although area and thickness are perfectly measured by high performance machines connected to the plant mainframe computer; the measurement of quality and subsequent sorting are criteria which remain subjective; their degree of variability depending upon the constancy of an operator's quality evaluation.

It is already realistic to envisage a machine with an ultrasound measuring device for use in wet blue or in pickle and for monitoring the physical make-up of hides; such as the METRONIC from CHARVO. Variations and faults would be detected, even those concerning dermis structure such as blind warbles, holes caused by parasite damage but undetectable from the surface, skin tumours, defects in horizontal and vertical fibres, excess fatty deposits and flay cuts.

Moreover, if an optical inspection system including a video camera were used for monitoring shape, it would be possible not only to measure the surface area but also to show up surface defects. Consider adding a micro-computer controlled moisture measuring system, then manufacture as a portable unit and you will have produced a highly efficient tool invaluable tothe tanner when dealing with raw materials suppliers. Already, various items are available which facilitate skin sorting after unhairing; such as sorting after wet-white pretanning or sorting with the aid of a fault revealing product (SORTASSIST from HODGSON) on limed, delimed or depickled skins.

3. MECHANICAL OPERATIONS IN THE WET STAGE

Two of the many mechanical operations carried out in the wet stage, namely splitting and shaving, require especially sophisticated monitoring.

3.1. The splitting machine

It has always been the most precise machine in the tannery and is now highly sophisticated. The performance of a modern splitting machine must meet the following minimum specification :

- Accuracy of splitting: better than 0.1 mm in blue and 0.2 mm in lime

  All functions and settings are to be hydraulically controlled

- Programmable variations in the splitting height at the shoulder and the belly

- Thickness in relation to the left or right split sides is to be adjustable

- Cambering of substance roller

- Adjustable splitting speed and slow lead-in speed for lime splitting

- Automatic bandknife advance system to compensate for wear

- Automatic control of bandknife hydraulic tension

And today even more elaborate refinements are available :

- Automatic programming of substance variations instead of return to manual control

- Slow feed speed can be combined with an increased head opening to facilitate insertion.

- Speed differential between the substance roller and ring roller improves skin spreading

All these features incorporated in modern machines render centralized control, programmable monitoring and fault detection automats essential. If these features were missing, the operator would require great dexterity and would spend too much time on adjustments.

Ancillary splitting equipment, such as extraction and stacking units cannot go unmentioned since they are now microcomputer controlled and have become essential in the industrialized countries. Extraction and stacking equipment developed by MERCIER can be connected directly to a mainframe computer to provide all necessary data on skin stack size and quantity.

3.2. Shaving machine

Though not as sophisticated as the splitting machine, increasing the width of shaving machines has also raised their potential because now heavier skins can be handled without loss of accuracy. Numerous electronic developments have been incorporated into these machines over the last few years :

- The development of complex grinding programmes which ensure that the knife cylinder is convex and avoid grinding while the machine is operating.

- Moveable support roller to protect the bellies.

- Programmed variation in the thickness of shaving during skin passage, with progressive return to initial thickness.

Variable opening and closing of the machine.

Today, with working speeds of 25 metres per minute, obtainable accuracy of thickness is better than 0.1 mm.

Moreover, delivery speeds of 50 metres per minute arre featured in some machines available today.

4. TRIMMING LEATHER

By definition, trimming the skin periphery is uneconomic. In the first place, it is labour consuming, moreover the amount of saleable leather is reduced and yet it remains unavoidable. Leather cannot be sold or even finished unless the edges are trimmed (frayed edges, tearing, fringes). Nowadays, various trimming methods and equipment are in use for trimming. Since cutting tools are essentially manually controlled, whether hand-operated, pneumatic or electric shears, the factors which determine trimming quality are operator skill and fatigue.

A new process is being developed in which a water jet is used in trimming, a video camera transmits an image of the cured skin and a computer processes the image. Thus, the system carries out the following operations in succession :

- Compilation of a reticulated image of the whole of the hide through a video camera

- Acquisition of the image signal which is converted into numerical code

- Processing of the signal in relation to cutting parameters to determine the points of the trimming profile.

- Memorization of these points in relation to the skin as a whole

- Effective control of the cutting tool after memorization of the trimming profile.

Naturally, trimming parameters permit presetting of the maximum percentage of leather to be trimmed, the size ot the irregularities to be eliminated, the distance from the edge of holes to be avoided and the distance between the untreated profile and trimming.

The prototype of this machine is already operational and if the results prove generally satisfactory this should lead to the avoidance of a particularly fastidious job in tanneries.

5. FINISHING

The most common application method remains automatic spraying. However, this has become highly sophisticated with the introduction of a whole range of control equipment which guarantees especially high performance. For example, the introduction of microprocessors into the pigment economiser system of METRAPLAN allows the following functions to be performed :

- Creation of special effects by spraying an area in front of the booth rear section (shadow effect) and availability of colour variation such as shading or spotting,
- Luminous display of the following data : total area painted, number of hides treated, hide overspray values both width and length, conveyor belt speed, rotary spray speed (in r.p.m.) speed of reciprocating spray (number of passes per minute). All data for these items can be stored in memory, even in the event of a prolonged power outage,
- Possibility of controlling up to 16 spray guns in a rotating booth or an oval path with a test run for each spray gun,
- Possibility of controlling two booths on the same line from a single control zone,
- It is also possible to manage up to 3 or 4 feed lines with finishing product, including a cleaning product line.

All these features provide considerable savings in pigment which can reach 30% or even higher. As a result, air pollution can be lowered, with air extraction and cleaning reduced.

Finally, it may be envisaged that, at some time in the foreseeable future, operation quality may be even further improved by applying continuous monitoring to the physical characteristics of finishing - such as : viscosity, temperature and particle dimensions.

6. MEASURING MACHINES

These machines are an essential part of the finished product control process in tanneries. They have now reached a very high degree of sophistication and accuracy. Modern machines, such as the METRONIC E from CHARVO carry out the following functions:

- Measuring the area of each hide in 1/10th dm^2, in tenths or quarter square feet

- Print out of areas on listing with two non-volatile memory totalizators (to cover power outages) and presetting of the required area and quantity.

- Automatic hot branding of the area of each hide into 7 segments using a numerical statistical system.

- Audible signal system for completed lot with classification per selection.

- Specialized programmes and connection to plant mainframe computer

- Automatic self-test of machine components with faulty operation detection

- Single or multi-point monitoring of hide thickness before despatch.

All these features enable a measuring machine to print out hide production statistics, subject to data corresponding to hide lots being processed at the same time; a true balance sheet can be raised to correspond with the raw material lots. And from this print-out, the most interesting sources of supply can be determined.

CONCLUSIONS

We have just looked at several examples of process control which have become increasingly accurate and in which tolerances have been tightened.

In fact, these are now an integral part of the operation and today, automatic continuous monitoring of dyed and finished leather colour has become possible with the SELLASET and MINOLTA systems which should provide a highly significant contribution to improving the quality of leather production.

Process monitoring and control at every stage of production has thus become indispensable if constant quality of output and user satisfaction is to be guaranteed, especially if the five zeroes for all modern companies are to be respected:

Zero Stock
Zero Delay
Zero Faults
Zero Breakdowns
Zero Paper

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PROCESS TECHNOLOGIES WITH REDUCED POLLUTION

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Introduction:

Any industrial production is associated with the problem of disposal of effluents. The effluent varies from simple chemical substances to toxic, harmful, noxious substances and materials varying in the degree of biodegradability. The effective solution to this problem can be achieved by either (i) de-pollution i.e. by adopting proper effluent treatment system for almost complete removal of pollutants or (ii) reduced pollution through process technology i.e. by adjusting the processing procedure in such a way as to reduce the harmful pollutants in the effluent as the process of zero pollution sounds theoritical at this stage.

Pollution can be reduced or eliminated by process modification, chemical and raw material substitution and/or recovery of byproducts. Since leather making involves the removal of non-collagenous materials from the skin and subsequent stabilisation of collagen by tanning, pollutants arise from both hides and also from incompletely absorbed chemicals used in processing.

In the leather processing, both liquid and solid pollutants are generated at various stages. With accumulation of more accurate data on the treatment of tannery waste management, it is becoming increasingly obvious that pollution abatement would be very expensive if tanneries were forced to meet the stringent limits enforced by effluent authorities. The principal causes for the high cost of tannery waste treatment are the large effluent volume and the high pollution load. The recurring and non-recurring cost of effluent treatment with most effective physico-chemical and biological treatment would work out cheaper when the voilume of the effluent to be handled and toxic load are reduced.

With the advancement of knowledge on process technology and availability of better processing vessels, designed based on chemical engineering principles, processes could be developed with improved uptake of chemicals, reduced input of water and consequently reduced pollutant load in the effluent.

The methods and techniques by which the pollution can be reduced or minimised are as follows:

- recycling techniques.
- use of newer processing vessels aiding better uptake of chemicals.
- substitution (at least partially) of harmful pollutants.
- development of alternative tanning systems.

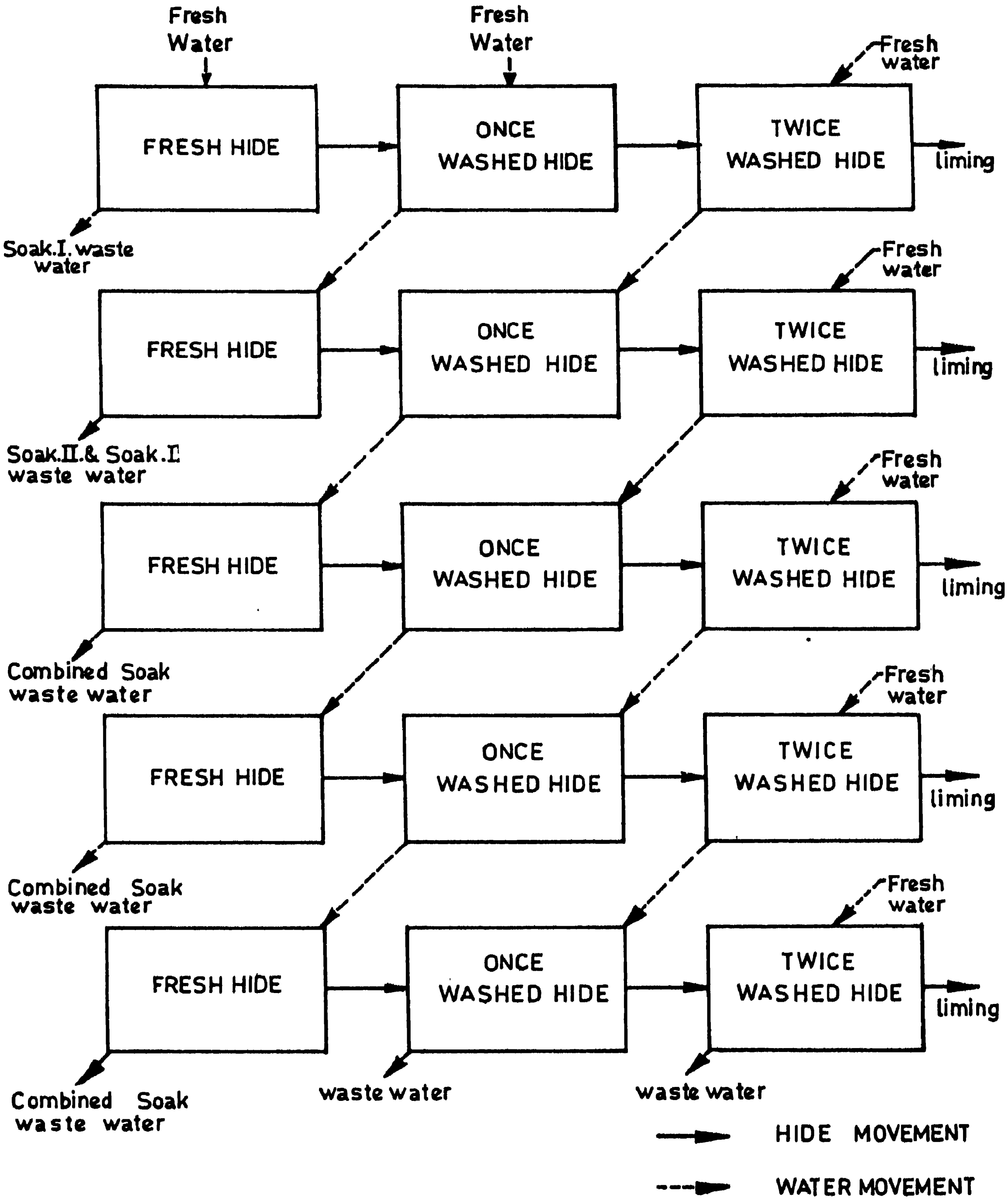
Results obtained through some of these approaches for various operations of leather making are reported below:

Soaking:

During the process of soaking the salted hides, dissolution of interfibrillary proteins like albumins and globulins occur due to the solubilising effect exerted by the salt solution. Consequently, the effluent from the soak yard would be rich in salt, protein degraded products, preservatives, bacteria and defilements and this constitutes about 20-25% of total load of effluent.

In general, soaking is done in 2 or 3 stages with change of water (quantity varying from 300-400%) each time. It has been found that by employing counter current reuse of soak liquor, the volume of effluent can be reduced to one-thirds without any impairment in the quality of the hides and without increase in the load of the effluent.

The counter current technique adopted for reuse of soak liquor is shown in Fig.1 and the characteristics of the liquors are given in Table-1.



COUNTER CURRENT SOAKING OPERATION

Fig.1

TABLE - 1

COUNTER CURRENT SOAKING OPERATION

Parameter	Control Soak I	Control Soak II	Control Soak III	Combined Soak II&I	Experiment Combined Soak	Experiment Combined Soak	Experiment Combined Soak	Combined Soak III&II	Soak III
	1	2	3	4	5	6	7	8	9
pH	7.25	7.80	7.76	7.33	7.47	7.55	7.52	7.84	7.91
BOD	943	330	110	1290	1400	1375	1200	325	100
COD	3960	1131	326	5019	5230	4820	4640	1254	294
Total solids	142184	21585	2778	161915	165495	163705	127280	20365	5025
Dissolved solids	114605	17260	2465	144420	145655	133570	110530	15800	4650
Suspended solids	27580	4325	310	17495	19840	30175	16750	4565	375
Chlorides	60350	10844	1980	64121	83924	77323	68836	10089	1886
Dissolved proteins	590	190	80	600	920	872	840	170	80

All the values except pH are expressed in mg/l.

It can be observed from the table that soak-III is the least loaded effluent with low chlorides and with low dissolved proteins and hence low BOD. This can be used for soaking once washed hide. The resultant effluent has its characterists similar to that of soak-II as can be seen from Column 8 & 2 of Table-1.

The effluent from soak-II can be used for pre soak or soak-I for fresh sides without any impairment in quality of hides and the resultant combined effluent is similar to the effluent from soak-I as seen from columns 4 & 11 of the Table-1.

This in turn offers a potential for counter current reuse of soak liquor without altering the properties of final leather.

TABLE - 2

COMPARATIVE VALUE OF SOAKING OPERATION

	Control 900% water used	Experiment 300% water used
pH	7.5	7.5
BOD	1383	1325
COD	5417	4898
Total Solids	166545	152160
Dissolved Solids	134330	129905
Suspended Solids	32215	22255
Chlorides	73174	76694
Protein	860	877

All values except pH are expressed in mg/l.

Control:	Total value of soak I + soak II + soak III operation (300% + 300% = 900% water used)
Experiment:	Average value of three experiments of counter current soaking method (300% water used)

Comparison between the three times used counter current liquor with that of the total effluent from three independent soaks is shown in Table-2.

By this counter current technique the soak liquor effluent volume decreased by 66%, without any additional pollution load. This system can be adopted by tanneries and can be extended to paddle soaking and drums as well. As the solar evaporating pans occupy major portion in any treatment system, reduction in soak liquor volume would effectively reduce the space required for the evaporating pans and hence the cost of construction.

Liming:

Recycling of lime liquors is very well known and is being practiced by the industry in the case of sulfide-free lime liquors. Attempts for counter current reuse of lime liquors have also been made [1] to reduce the effluent from lime yard.

However with the modern liming systems, involving sharpening agents, recycling systems with replenishment of lime and other additives may be rather difficult to control in regular production.

Deliming:

Considering the beam house operations of deliming and pickling, where the reaction is one of diffusion followed by chemical combination, the concentration gradient plays a vital role. Conventional deliming in drum, involves use of large quantities of water in order to minimise the mechanical action and thus preventing the damage to grain of the pelt which would be tender at this stage. Since the reaction of the deliming agent with collagen is non-stochiometric, due to the complex nature of the substrate, relatively higher quantities of deliming agent than the theoretical requirement is used.

However it is possible to reduce the float and chemicals used for deliming, retaining the concentration gradient as in conventional drum, by the possible use of newer processing equipments which are designed to provide gentle mechanical action in contrast to the drum.

The hide processor and compartmental (Y) drum offers such possibilities.

Based on the design of the equipment, the advantages claimed for the hide processor are:

- Gentle mechanical action, consequently better grain characteristics of final leathers.
- Pumped recirculation system offering better scope for lower liquor hide ratios and hence less effluent.
- Easier loading and unloading of hides.
- Lower power requirement due to reduced starting torque.
- Minimum space requirement.

However, when hide processors are used longer processing time is required.

In order to monitor the efficiency of the hide processor in the operation of deliming, the hides were cut into sides and the rights were processed in the hide processor with the corresponding left sides being processed in the drum. After deliming both the sides were pickled and chrome tanned in the conventional wooden drum.

By conducting a series of experiments, varying the float and the amount of deliming agent used, the savings obtained in chemical and water input in the hide processor are given in Table-3.

TABLE - 3

SAVING IN CHEMICALS AND WATER IN DELIMING

Processing Vessal	% of water used	% Ammonium Chloride used
Drum	100	1.0
Hide Processor	60	0.75
Saving (in hide processor)	40	25

The leathers were then analysed for uptake of chromium and the shrinkage temperature of the leathers were determined. The values are given in Table-4.

TABLE - 4

COMPARISON BETWEEN CONTROL AND EXPERIMENT

Control	% Cr_2O_3	T_s °C
Drum (Deliming)	3.12	108
Experiment (Deliming in hide processor)	3.08	109

In all these experiments, only one deliming agent has been tried. However the system can be extended to other deliming agents also.

Pickling:

In the process of pickling the hides are treated with acid, in presence of salt solution which is employed to prevent swelling of the protein. It is kinown that, whilst almost the total quantity of acid used for pickling is taken up by the protein, only 40-45% (3% out of normal 8% of salt based on pelt weight) is taken up by the pelt and the rest is let out in the effluent. This amount of sodium chloride is normally mixed with other discharges of the tannery and adds up to the total dissolved solids of the effluent. Despite the efforts by different researchers, as such there is no economical method for eliminating sodium chloride used in pickling.

Similar to deliming, building up of concentration gradient of salt same as that in the conventional drum, using hide processor pickling has been tried.

As mentioned earlier, the hides were cut into sides and rights were pickled in hide processor and lefts in the conventional drum. The sides were then chrome tanned in the conventional drum. The savings in chemical and water input are given in Table-5.

TABLE - 5

SAVING IN CHEMICALS & WATER IN PICKLING

Processing Vessal	% of salt used	% of water used
Drum	6	60
Hide Processor	4	40
% reduction in hide processor	33 1/3	33 1/3

The wet blue obtained in the hide processor was comparable with control with respect to both chrome fixation and hydrothermal stability. The leathers had also uniformity in colour and were smooth grained in both cases.

The saving in chemical and water input in the process of pickling was as high as 33% and further this system also offers a scope for recycle and reuse of pickle liquor with appropriate replenishment.

Chrome Tanning:

Emphasis is now laid on this unit operation because of the increasingly stringent limits applied world-wide to the concentrations of chromium permitted in the effluent. Despite the relative non-toxicity of trivalent chromium (2-5) limits as low as 1 mg/l of chromium have to be met now. With the conventional processing, exhaustion rates of around 70-80% are typical (6), producing a residual chromium concentration in the spent tanning liquor of around 4000 mg/l or more and dilution of this liquor with other tannery effluents might lower this only upto 100 mg/l or more. Apart from the environmental impact, these relatively low exhaustion rates involve substantial economic losses.

In India, it is estimated that about 28,000 tonnes of basic chrome sulfate are being used annually. With the exhaustion rates around 70-80%, chrome tanning salts equivalent to nearly 1800 tonnes of Cr_2O_3 are discharged in the effluent [7].

However, there are claims in the literature that chrome exhaustion can be increased to 90-95% using (a) some commercial additives [8,9] (b) recycling procedures [10] (c) high final temperature of tanning [11-13] (d) high final pH [14,15], and (e) usage of self basifying tanning agents [16-18].

The basic rate equation for any process is

$$\text{Rate} = \frac{\text{Driving Force}}{\text{Resistance}}$$

The driving force for the chrome tannage is the concentration of chrome and the simplest way to obtain a high concentration is to use a low float.

In order to combat the poor exhaustion problems, attempts were made to develop low float system with gentle mechanical action of the hide processor. Since the addition of salt in tanning is mainly to prevent acid swelling, effective concentration gradient plays a vital role and hence the total am ount of salt used can be reduced considerably in line with the reduced quantity of water used for tanning in the hide processor.

By varying the total float used for tanning, keeping the amount of Cr_2O_3 offered constant (1.5% based on pelt weight) a series of experiments have been carried out to explore the possibilities of savings in water and chemical input in chrome tanning. The wet blue leathers were analysed chemically for fixed Cr_2O_3 and the shrinkage temoperature of the leathers were also determined. The analytical data is given in Table-6.

TABLE - 6

INFLUENCE OF FLOAT RATIO ON CHROME TANNING

	Drum	Hide Processor	Drum	Hide Processor	Drum	Hide Processor	Drum	Hide Processor
Total Float (%)	100	100	80	80	60	60	40	40
% of NaCl used	4	4	3	3	2.5	2.5	1.5	1.5
Fixed Cr_2O_3(%)	3.2	3.4	3.36	3.62	3.54	3.79	3.68	3.96
T_S °C	106	107	106	107-109	108	110	110	112-113
Time taken for penetration(min)	45	110	40	90	30	75	25	55-60

Though the time required for penetration of chrome is slightly high when hide processor is used, there is considerable improvement in fixation of Cr_2O_3 for the same amount of chrome offered. More significantly the wet blue from the hide processor was fuller in substance with smooth grain and uniformity in colour in contrast to the wet blue with a tendency to drawn grain and non-uniform colours as obtained from the drum with reduced float.

Such a system, with improved chrome uptake offers a scope for reduction of amount of chrome used for tanning, if the leathers were required just to stand the boil test. So with this view, using the reduced float system in hide processor, the amount of chrome offered was varied and it has been found that 4% Basic Chrome sulfate was sufficient to impart significant hydrothermal stability to the leathers. The results are shown in, Table 7.

TABLE - 7

VARIATION IN UPTAKE OF Cr_2O_3 WITH BASIC CHROME SULFATE USED

	6%	5%	4%
% Fixed Cr_2O_3	3.96	3.02	2.69
T_S °C	112-113	106	102

Further, hide processor offers better scope for adopting the high chrome exhaustion techniques like use of high temperature, recycling etc. due to inherent design of the equipment.

Pickle - free Alum - Chrome combination tannage

Another possible approach for reduction of chrome in the effluent is to substitute chrome partially by other tanning agents. There is extensive literature relating to the use of aluminium salts in conjection with chrome salts [19]. Apart from improving the grain quality and uniformity, aluminium pretanning has been found to improve uptake of chrome. Aluminium pretanning is supposed to orient and mask the reactive ionised carboxyl groups of collagen. Evidence to this hypothesis is slow release of aluminium which takes place during chrome tanning, resulting in improved uptake and better distribution of chromium. Because the carboxyl groups are pre-oriented, as the pretanning agent is displaced with the formation and more stable protein carboxyl - chromium bond, more cross linking takes place. [20]

When alum [K_2SO_4, $Al_2(SO_4)_3$ 24 H_2O] dissolves in water, hydrolysis takes place, leading to formation of a soluble basic aluminium salt [Al (OH) SO_4] and an equivalent amount of free mineral acid. When a delimed side enters such a solution, free mineral acid is taken up and fixed by collagen similar to pickling. This results in further hydrolysis of aluminium salt. This property of alum has been advantageously used for combining pickling and pretanning operation, without addition of external acid for pickling. Potassium sulfate present along with aluminium sulphate can function as a neutral salt, enabling substantial (to an extent of 75%) reduction in use of sodium chloride during pickling.

A series of experiments have been carried out on cow hides to fix the amount of alum required to get a pH of 2.8. After pretanning with alum, the sides were subsequently tanned with basic chrome sulfate, keeping the total mineral oxide (equal to 2%) same as that of conventional chrome tannage with 8% basic chrome sulfate.

The leathers were then checked for the hydrothermal stability and uptake of mineral oxides. The results are shown in Table-8.

TABLE - 8

	Conventional Chrome Tanning	Alum-Pickle Combination Tanning
Sodium Chloride used for pickling	8%	2%
Acid used for pickling	1%	-
Amount of Alum used	-	8%
Amount of BCS used	8%	4%
% Al_2O_3 fixed	-	0.8
% Cr_2O_3	4.2	3.6
Tensile Strength (kg/cm^2)	215.5	213.5
Grain bursting strength (Kg/cm)	20	18

The salient features of this process are:

- elimination of addition of external acid for pickling
- reduction (to an extent of 75%) in use of salt for pickling
- reduction in chrome offered, without impairment in properties.
- higher exhaustion of chrome
- amount of fixed Cr_2O_3 very near to that of control despite 50% reduction in input.

NEWER TYPE OF TANNAGES

With the Indian industry emerging as one of the leading exporters of finished leathers and leather goods, from a stage of semi finished leather exporter it is necessary to develop a suitable crust, which would combine the properties of chrome and vegetable tanning materials, overcoming the disadvantages of both. Such a tannage would have greater potential in years to come.

Extensive work has been carried out at CLRI, for the development of such a tanning system using salts of zirconium and aluminium with small amounts of basic chrome sulfate. The incorporation of basic chrome sulfate is to impart hydrothermal stability to the leathers, while aluminium sulphate is used to impart mineral character to the leather, such as improved dyability, softness etc. Zirconium on the other hand makes the leathers easily wettable and full like vegetable tanning. Apart from this Zirconium due to its inherent nature contributes white colour to the crust. The advantage of this crust over other systems like wet white, which is essentially a reversible pretannage, is that it can be dried and stored in dry condition, after addition of small amount of cationic fatliquor along with tanning salts.

The amount of tanning salts offered and fixation of mineral oxides are shown in Table-9.

TABLE - 9

Mineral Oxides	% used (based on hide substances)	% fixed in leather
Cr_2O_3	0.82	0.64
Al_2O_3	3.30	2.12
ZrO_2	3.96	3.02

The advantage of this alternate crust over the existing systems are:

- white base, enabling rich dyeing
- amenable for storing in dried condition, enabling ease of transport and selection
- Versatility, as any type of finished leather could be made from such a crust
- possess hydrothermal stability with shrinkage temperature around 105-106°C
- the crust leathers are full in substance offering scope for reduction of retanning agents subsequently.

Conclusion:

With the increasing stringent measures on pollution load, the leather industry is forced to look in for improved environmental tannery processing. The difficulty associated with the tannery effluent are its large volume and high pollution load. CLRI has developed the following processes to overcome these difficulties by adopting water conservation and improved chemical uptake technologies.

- Counter current recycling of soak liquors.
- Reduction in water and chemical input during deliming and pickling by the use of newer processing vessels.
- Partial substitution of chrome by Alum - pickling
- Development of alternate crust

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SESSION II : LEATHER PRODUCTS TECHNOLOGY

DESIGN, STYLE AND FASHION IN LEATHER INDUSTRY

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ABSTRACT

1. The Role of a Stylist in a Company

- Styling is a relatively new profession.
  Mass production systems after the war. Necessity to capture the market and its needs.

- Present Mission: A stylist as a creator and innovator or a stylist as a radar, as an antenna tuned to various trends.
  According to the style of products. Differences between a Company stylist and a free - lance stylist.

- Style/Industry
  Integration : The Stylist goes beyond creation, is involved at all levels of the Company, technical, marketing, commercialisation, communication.

2. The functioning of a Styling Office in the leather trade

- Objective : Definition of trends at all industrial stages.

- Methodology :
  1. Search for information (Phase of analysis)
  2. Definition of trends (Phase of Synthesis)
  3. Coordination of industries (Phase of communication)

  Support of creation:
  1. Distribution (communication and exhibitions/fairs)
  2. Press (professional - fashion - general public)
  3. Emergence of talents, help to Stylists, meeting platforms (competitions, fairs)

Conclusion: Future of Styling in France as a spear-head of the leather industries.

FOOTWEAR COMPONENTS

Roger Robinson,
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COMPONENTS USED IN THE MANUFACTURE OF FOOTWEAR

1. LASTS-PLASTIC AND WOODEN
2. TOE PUFFS AND COUNTERS
3. INSOLE BOARDS
4. GRINDERY
5. ADHESIVES
6. SOLING MATERIALS

FORM	Leather All tannages	Vulcanised Rubber			Crepe Rubber	Thermoplastic Rubber			PVC	PVC Blends	
	Solidsbends cut,soles, built units & insert moulded	Solid Sheet	Units & moulded on	Cellular sheet, units & moulded on		Solid units and moulded on	Hard sheet and moulded top pieces	Cellular units and moulded on	Solid units moulded on and some sheet	Solid units and moulded on	Cellular units & moulded on
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
COMPOUND COST PER KG.	264-352	85-120	85-120	105-140	85-95	90-100	90-100	95-105	50-63	72-85	75-90
DENSITY RANGE	0.95-1.05	1.05-1.40	1.05-1.40	0.3-1.10	0.88	1.0-1.10	1.0-1.10	0.7-0.9	1.18-1.23	1.16-1.20	0.7-0.9
COST PER UNIT VOLUME	264-352	104-147	104-147	74-98	75-84	0.00	95-105	76-84	60-76	85-100	60-72
WEAR MEDIAN	0.40	0.7	1.80	0.70	1.70	1.10	1.10	0.80	1.70	2.50	1.50
WEAR 2/3s RANGE	0.3-0.8	0.5-1.1 F.M.	1.0-3.0 M to E	0.5-1.0 F to M	1.5-2.0 Good	0.8-1.5 F to G	0.9-1.8 M to G	0.5-1.4 F to G	1.3-1.9 Good	2.2-2.6 G to V.G.	1.2-1.9 M to G
CRACK RESISTANCE	Good	Good	G to E	Good	V.G.	Good		Satisfactory	Satisfactory. Can be a problem at low temp.	Satisfactory	Satisfactory
ADHESION	Normally satisfactory,but requires thorough roughing and two coats of polyurethane or polychloroprene adhesive	Good, after scouring with neoprene adhesives and after halogenation or special primers with PU adhesives	Units as above. Moulded on-good with special vulcanising adhesives	As in 4	Good with special primer or halogenation and neoprene or PU adhesives.	Good after halogenation with PU adhesives. Good,after solvent wiping (petrol ether) with special neoprene or PU adhesives. For moulded on special adhesives are required.	As in 7	As in 7	Units and sheet good with PU adhesives after solvent wiping.Moulded on good with PU adhesive, No adhesive required with some materials e.g. textiles.	As in 10	As in 11, but light roughing of units may be better than solvent wiping

	SOLING			
	Polyurethane reaction moulded	Polyurethane Thermoplastic	EVR(crosslinked)	Nylon
(1)	(2)	(3)	(4)	(5)
FORM	Cellular-units and moulded on Solid (145-170)	Solid Units and moulded on Moulded top pieces(200-220)	Cellular sheet built units and caster units	Solid unit or moulded on
COMP.COST/KG.	145-170	200-220	220-250	220-420
DENSITY RANGE	Solid (1.1 to 1.2) 0.4 to 0.6	Moulded top pieces (1.24 to 1.28) 1.24 to 1.28	0.2 to 0.4	1.13 to 1.15
WEAR MEDIAN	Solid (6.00) 2.00	Moulded top pieces (2.10) 4.40	0.60	0.90
WEAR-2/3 RANGE	Solid (5.0 to 7.0) 0.8 to 2.8(Fair-V.Good)	Moulded top pieces(1.3 to 3.2)Good-Excellent 1.7 to 7.0(Good-Excellent)	0.4 to 0.7	0.6 to 1.2
CRACK RESISTANCE	Satisfactory,but there can be problems Solid: Satisfactory-good	Good	Good	Adequate with correct unit design
ADHESION	Units usually need roughing before bonding with PU adhesives. Self adhesive when bonded onto leather. Solid: -do-	Units satisfactory with PU adhesives after solvent wiping	Normally satisfactory with neoprene adhesives after scouring or with isocyanate or special primars and PU adhesives High polyethylene EVR's may give trouble.	Consistant,good adhesion may be difficult.Usually requires roughing+ isocyanate or other special primers and neoprene or two part PU adhesives.
SLIP RESISTANCE	Solid:Moderate-good with pattern	Hard grades can be slippery Moulded top pieces: Normally satisfactory depending on shoe style	Can be slippery on some surfaces	Can be slippery
OTHER PROPERTIES	Good oil resistance.Sometimes absorbs water	Correct compounding,storage and moulding conditions important for optimum properties. Moulded top pieces: As above.	Heat shrinkage should be checked	Can wear to a sharp edge.
SHOE MAKING ASPECTS	Most durable of the low density cellular solings-comparable with many solid soles.Very versatile.Can be be given a solid feel. Additional applications-sports solings or outer skin of two part mouldings.	For sports shoe solings or outer skin of two part mouldings with softer compounds Moulded top pieces: Used for ladies top pieces - most durable material available for small size top pieces-can be moulded round metal spigots for stiletto heels.	Composition varies widely-often blended with SBR and/or polyethylene with reinforcing silica or whiting fillers. Clear colours and very uniform cell structure.	Some sports applications e.g.football boot soles, running.

1	2	3	4	5	6	7	8	9	10	11	
SLIP RESISTANCE	Normally satisfactory, but can be slippery on dry and when heavily saturated on wet surface	Good	Good	Good	Good on dry surfaces, slippery on wet surface	Very good	Good	Very Good	Can be slippery, especially the harder grades	Can be slippery	Can be slippery, but better than solid
OTHER PROPERTIES	Not Water proof		Oil and heat resistant types available	Heat shrinkage should be checked	Sensitive to oil, heat and direct sunlight	Very sensitive to oil and solvents	-do-	-do-	Oils & solvents leach out normal plasticisers. Wears very smooth	Wears very smooth	
SHOE MAKING ASPECTS	Normally reserved for high class shoes. The cutting trimming & finishing necessary add further to the cost. Is water vapour permeable	Normally compounded with high styrene resin	Excellent general purpose soiling in every respect. Can be compounded to suit requirements. Price dependent on type of compound and base polymer.	Very difficult to mould to shape (unless sponge with intercommunicating cells) so soles have to be cut from sheet. Good material for casual footwear.	Soles need to be cut or made from sheet. Lightest solid soling with good durability	Compounds can be oil extended and/or silica reinforced	Hard sheet for repairers use(top pieces) can be filled to give better finishing. Problems of 'creep' in wear percludes use for very small top pieces and for use in thin walled heel blocks	Smooth surface difficult to produce because of 'swirl' and 'fish-scale pearl' effects-so stippled mould surfaces or colour finishing usually necessary Edge trimming can expose cellular structure.		Blending can improve oil resistance & durability	As above. Blending also improve flex crack resistance. Smooth surfaces difficult to produce. Stippled mould surfaces usually necessary.

RESIN RUBBER

PROPERTIES

	MENS	LADIES
HARDNESS (IRHD)	88 (MIN)	93(MIN)
DENSITY (G/CM^3)	1.35(MAX)	1.35(MAX)
TENSILE (KGF/CM^2) STRENGTH	75 (MIN)	65 (MIN)
EXTENSION (%)	200(MIN)	200 (MIN)
COMPRESSION SET	35 (MAX)	35 (MAX)
FLEXING (MM CUT GROWTH PER KC)	0.1(MAX)	0.1(MAX)
ABRASION RESISTANCE (VOLUME LOSS)	350(MAX)	400 (MAX)
SOLE ADHESION (KG/CM^2)	3.0 (MIN)	3.0(MIN)
THICKNESS (MM)	4.3(MIN)	2.7(MIN)

QUALITY CONTROL OF SHOE UPPER LEATHER

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In the recent years, the developments in the shoe and leather industries as well as the textile industry have shown that great efforts have to be made to comply with the ever-changing demands of fashion. To meet the requirements of high fashion designers, more importance must often be attached to the appearance than to the physical properties of the leather. The consumer, however, expects a high fashion article to be of the same quality as a less fashionable, classical product with regard to material and workmanship.

In reviewing the fashionable types of leather, I should like to deal first with the leather as such and then with the finish.

In the recent years, fashionable soft leathers have been used on an increasingly larger scale for the manufacture of foot-wear and this trend seems to continue.

Very soft leathers, however, involve considerable problems, because they have to be reinforced and interlined to render them suitable for processing into foot-wear. The requirements imposed on upper leather differ substantially from the types used for the manufacture of clothing, fancy articles and bags. To explain the reasons for the difficulties involved in meeting these requirements, I have to go more into details.

The types of leather that we have to deal with are chiefly nappa hides and goatskins which are now required to be very much softer than only a few years ago.

Other types of leather include bastardskins and lambskins that are used in increasing quantities for foot-wear manufacture not only because of their softness but also to solve the supply problem in the upper leather sector. It should be pointed out that a tanner producing a leather often does not know that it will be used for the manufacture of shoes. To meet fashion requirements, leathers similar to those for garments and bags are often used for footwear without giving consideration to the severe stressing to which shoes are submitted during wear. This is the reason why the leather has to be reinforced and interlined for shoe production.

The softness required is imparted to the leather during tannage in the opening-up process that produces a soft, loose fibre structure. Suppleness is achieved by fatliquoring and retanning. In this connection, I should like to describe the structure problems of the leathers first and the finishing problems later on.

The soft leathers that we have to deal with are chiefly hides and calfskins including glazed kid that have been submitted to a strong opening-up process. Bastard-skins and lambskins also give rise to the same sort of troubles. With all these types of leather, especially with lambskins, the loose structure or high stretch and the low cohesion within the skin may result in pipiness.

The soft leathers are extremely extensible and particularly their permanent distention value is very high. This has been dealt with in various studies of our institute where instruments have been developed for measuring the distention and permanent distention under a very low force, e.g., 750 mbar simulating the conditions that occur when shoes are worn.

The values determined in the tests show that the permanent distention of normal leathers lies at 2-3 %, that of softer leathers at 3-5 % and that of extremely soft leathers at 6-9 %. This makes clear how great the differences are. It also shows that certain measures have to be taken when the leathers are used for the production of foot-wear to avoid that the leather or the shoes widen excessively during wear. For this reason, care must be taken in reinforcing the leathers with a suitable interlining.

In the shoe factory, the structure problem becomes very distinctly apparent when the leather has to be laminated with an interlining or when reinforcements have to be bonded to the underside of the leather in the tip and heel area of shoe uppers, as is normally done anyway.

The leathers tend to wrinkle particularly in the areas where they are excessively soft. In extreme cases, even the smallest fixation on the underside of the leather may cause undesirable wrinkles to form on the grain side. It may well happen that a leather showing this behaviour is no longer suitable for shoe production. There is frequently reason for this kind of complaints which often leads to unfriendly discussions between leather producers and shoe manufacturers.

Deficiencies of this kind are normally not visible on the leather until it is laminated with a reinforcement material or fixed lightly on the reverse side.

Such defects can be simply detected by sticking a strip of adhesive tape to the flesh side of the leather and bending it in the direction of the grain side. The place where the adhesive tape is attached to the flesh side will then become visible on the grain side. This can serve as an indication that the leather will cause trouble in shoe production. I have already mentioned that all leathers have to be reinforced anyway for foot-wear production. This fact should be considered in the leather production process to avoid any excessive opening up of the hides and skins. It should also be pointed out that in using leathers for foot-wear production, the adhesive used should be applied only to the lining or interlining and in lamination by plating the adhesive should be applied in spots.

On patent leathers, wrinkling and loose grain will appear even more pronounced when the reverse side is fixed or laminated with an interlining. Patent leather should therefore not be as soft as nappa leather or other types of soft leather.

Grain cracking, a problem formerly often encountered in shoe manufacture, hardly occurs any more, because of the moistening devices that are installed. Any grain cracking still occurring today is usually due to a defect of the tanning process.

Another point that I should like to outline briefly is that regarding the fatliquoring of modern soft leathers. But first let us discuss the problem of stains caused by fatty spue.

Fatty spue formation on finished shoes and leathers has been lately observed more frequently. Although it has no direct effect on the quality of the leather, this deficiency is not acceptable by shoe sellers, because they cannot be expected to wipe the spue continuously from the shoes before they can be sold. Fatty spue is often due not only to the amount but also to the composition of the fatliquoring agent or fatliquoring mixture used.

Fatty spue usually forms when the fatliquoring mixture contains a very large proportion of hard fat. Excessive amounts of fat, of course, are the actual cause of fatty spue but the proportion of hard fat plays a decisive role.

When the fat in the leather is degraded by bacteria, the resulting free fatty acids with a high melting point may also cause formation of fatty spue. Attention should be paid to the fact that it is not absolutely necessary to use a very large amount of fat for the production of soft leathers. This should be kept in mind especially when the skins contain a large amount of natural grease as, for instance, the bastard and lambskins. The high fat content of the leathers interferes with the shoe production process and provisions should be made to ensure that the extractable fat content of the leathers does not exceed 12 %.

In this connection, we should also go briefly into two problems that are often the subjects of complaint, viz. the odour of the leather and formation of mould.

Especially in your countries, it is important that suitable products of good quality are used for fatliquoring and that the leathers are properly treated in an odourless preserving process, because it often happens that mould growth is promoted by high humidity and heat during transportation. The offensive odour of leathers imported by us often gives rise to complaints. In many instances, analytical examinations have revealed that the odour has been caused by unsuitable or contaminated preserving agents. There are, of course, also cases where poor quality fatliquors have caused the offensive odour to which consumers rightly object.

Tests have also revealed the presence of phenolic compounds which cause objectionable odour. It should be pointed out that this has been observed in an increasingly greater number of cases and that the problem of objectionable odour should also be considered by the tanners producing pretanned leathers. It is also possible that wetblues and crust leathers already have an offensive odour.

As I have mentioned just now, the cases of mould growth on upper leather are occurring with increasingly greater frequency. This, of course, may also be due to the modified regulations concerning the use of preserving agents.

These points should be closely observed and corrections should be made to avoid difficulties during transportation and with dissatisfied consumers.

And now to the finish problems.

The object of finishing is to impart the desired appearance to the leather and to protect it from damage. The finish is therefore of decisive importance with regard to the suitability of the leather for the purpose intended, provided, of course, that the leather as such is in a perfect condition. This has been the case in 90 % of the complaints received.

The types of finish required for fashionable leathers have changed considerably in the past few years. Only 15 years ago, strongly pigmented finishes used to be customary, whilst today more or less transparent aniline finishes are predominating.

The shade of a leather, of course, is a very important factor. The colour fastness that the leathers to be processed without lining or the lining leathers themselves are required to possess is of special significance. The leathers are mainly required to possess satisfactory colour fastness, wet rub fastness and fastness to perspiration. These are the requisite properties which an upper leather has to possess and which normally can be readily achieved, if suitable dyes of perfect quality are used and the colouring process is carried out properly. The requirements imposed on the rub fastness properties, however, are much more difficult to meet on full grain leather by dyeing and light finishing than on lightly buffed or corrected grain leathers by application of fairly thick pigment finishes. The reason for this is that better adhesion of the finish is achieved on a rough corrected grain surface than on a relatively smooth full grain surface.

The adhesion of the finish is decisive for the flexing endurance of the finished leather. Adhesion and flexing endurance are dependent largely on the finishing products and the finishing method used.

Since the base coat formulation, which is usually based on dispersions, can penetrate a corrected or buffed grain surface more readily than a closed full grain surface, the anchorage of the base coat achieved is accordingly. The depth of penetration of the base coat formulation, of course, is also dependent on the fineness of the dispersion used.

In this respect, considerable improvements have been made. Even wet adhesion values that fully meet the requirements imposed can now be obtained on full grain leathers.

The solution to these problems is particularly important today, because increasingly greater efforts are now being made to work solely with aqueous finishing products. The requirements imposed, however, are more difficult to meet with water-based than with solvent-based finishes.

I feel sure that solutions will be found to this problem, if no excessively high physical requirements are imposed which cannot always be met anyway in the fashion sector.

A certain minimum degree of adhesion of the finish, however, has to be maintained, in order to ensure that satisfactory wear properties can be achieved. Because in the shoe factory, an additional coat of finish is applied at the end of the manufacturing process to give the shoes a certain finishing touch.

This additional finishing coat increases the physical load on the original finish of the leather. This may cause trouble on leathers with aniline finishes that may not have shown any reason for objections in a previous superficial flexometer test. Even extremely fine hair cracks in the finish of this kind may cause trouble on the finished shoe, if the final finishing coat is applied to the shoes in the manufacturing process. The use of a finish based on wax with less pronounced film forming properties would be more suitable for this purpose.

It should be pointed out specifically that the wet adhesion of the finish is of very great importance. It often happens that the base coat softens under the action of moisture and as a result the adhesion of the finish is impaired. Special attention should therefore be paid to the application of the base coat, because the quality of the leather is largely dependent on the care exercised in formulating and applying the right base coat.

The fatliquoring of the leather also has a great influence on the adhesion of the finish. Better adhesion on the fatliquored leathers is achieved with solvent-based finishes than with aqueous finishes. Care should be taken that the base coat and the top coat are suited to one another, i.e., they should possess the same elasticity and physical properties, as otherwise trouble is to be expected. Mistakes are often made in this respect.

The finish has to meet certain dry and wet rub fastness requirements, in order to allow proper leather care to be carried out. If these requirements are not fulfilled, troubles will result in the shoe manufacturing process. Stain marks left on the leather of the shoe during the manufacturing process have to be removed by washing and trouble is caused, if the leathers do not possess satisfactory fastness properties in this respect. Poor fastness properties will reduce the wear properties of the shoes. Stains may easily form on the leather that does not stand up to normal leather care.

Another property that especially the light-coloured leathers should possess is light fastness and fastness to change of shade that occurs under the action of heat after exposure to light.

These properties are largely dependent on the kind of finish applied and on the binders used in the finishing formulations.

I guess you know how important the light fastness is and that you are familiar with the problems involved.

Satisfactory heat resistance is a property that is difficult to achieve. I shall answer any questions that you may have to this subject in the subsequent discussion.

It is of equal importance that light-coloured leathers possess satisfactory cold crack resistance. To meet this requirement, the finish of the leather must have sufficient elasticity. With light-coloured leathers, the problem is not so easy to solve because of the high proportion of pigments contained in the finish.

Although it is not so serious in your country, this problem plays a decisive role when the shoes or leathers are exported. At sub-zero temperatures between 0 and -10 °C or even -15 °C, which may well occur in Europe, cold-crack damage may be caused to the leathers or shoes even during transportation.

In the recent years, there have been numerous complaints about the discoloration of leathers that have been processed in combination with polyurethane sole material.

It is a well known fact that polyurethane in conjunction with nitrocellulose causes yellowing and destruction of the finish due to the accelerator in the polyurethane system.

Attention should be drawn to the fact that even the smallest proportion of nitrocellulose, not only in the top coat, will bring about this kind of discoloration. No product has been found yet that could replace the accelerator (Dabco) in polyurethane. For this reason, the leathers that are to be processed in conjunction with polyurethane should be free of nitrocellulose.

Finally, it should be pointed out that it is important to test and determine the tendency of the leathers to discoloration in conjunction with adhesives. Discolorations that occur on shoes, however, are usually not due to faults of the leather but to the adhesives which may contain substances that have a discolouring effect on the finish of the leather.

This concludes the outline of the problems involved in the quality control of fashionable upper leathers.

I shall now be pleased to answer any questions that you may have.

SESSION III : PANEL DISCUSSION

on

MANPOWER, MARKETING AND MANAGEMENT FOR LEATHER/LEATHER PRODUCTS SECTOR

INDUSTRY'S VIEW POINT

TANNERS GET-TOGETHER - 1989

PANEL DISCUSSION ON

MANPOWER, MARKETING AND MANAGEMENT FOR LEATHER/LEATHER PRODUCTS SECTOR

ISSUES

1.0. MANPOWER

1.1. Is manpoweer a major constraint for futher growth of leather industry in India: If so, which of the following sectors, it is accute?

- Raw material collection, handling and marketing
- Production of (a) Leather
    - * Beam house
    - * Tanning
    - * Finishing

  (b) Leather products
    - * Footwear
    - * Garments
    - * Leather goods
    - * Others
- Effluent treatment
- Quality control
- Management
    - * Material
    - * Personnel
    - * Production
    - * Financial
    - * Administrative
    - * Marketing
    - * Sales

1.2. What type of policies are needed to achieve the necessary growth of manpower at various levels?

1.3. What is the status of Indian training facilities in leather and leather products sectors? Are they adequate? If not, what measures are required to strengthen them?

1.4. What role leather industry can play in the development of manpower? What type of linkages are necessary between the industry, government and/or academic institutions to achieve the desired goals?

2.0. MARKETING

2.1. What are the major constraints coming in the way of international marketing of Indian leather/leather products?

2.2. How effective is market forecasting in Indian leather field? If not, what factors responsible?

2.3. Is domestic market for leather products constrained due to the current emphasis on export market? If so, what policites are required to maintain an optimum balance of growth between them?

2.4. How to formulate marketing strategies for leather products to meet the growing international competition from Asian countries?

3.0. MANAGEMENT

3.1. Are the existing managerial practices in Indian leather and leather products industries adequate to meet the growing challenges in the next decade? If not, what strategies or steps are required to strength them?

3.2. How to attract young and qualified managers to the leather industry particularly in small scale units?

3.3. What should be the basic prerequisites to become a good manager in leather and leather products industries? Are they different from the other sectors of industries?

3.4 Leather products sector is attracting many multinational companies in India. They have a strong and aggressive managerial base. Can the traditional leather product units stand against them? If not, what steps are needed to meet the challenges of new situation?

POSTER SESSION

FATLIQUORS BASED ON LONG CHAIN ALCOHOLS

Geetha Baskar, K.Vijayalakshmi, K.Parthasarathy,
V.V.M.Rao and S.Rajadurai

Esters and interesters of long straight chain alcohols and fatty acids/triglycerides and their sulphated fatty derivatives were prepared. The physico-chemical characteristics of the esters and the fatliquors were determined. Evaluation of the developed products revealed their scope as suitable replacements for synthetic and sperm oil based fatliquors.

Central Leather Research Institute, Madras.

CONSERVATION OF WATER IN SOAKING

K.A.SHANMUGHASUNDARAM, D.H.KAMAT, K.S.JAYARAMAN &
W.MADHAVAKRISHNA

Conventional soaking operation consumes large quantities of water (i.e.900%-1200% based on raw material weight) and discharges approximately equivalent amount. By adopting the counter current method with cascade principle, it is possible to reduce the quantity of the input water used in soaking and thus the waste water generated in that operation. This process can also be extended when drums and paddles are used.

Five batches of skins have been processed using this process to illustrate the feasibility of the method. It is observed that this method reduces water consumption by 66.66% as compared to the conventional method. The characteristics of waste water is similar to one obtained by conventional soaking operation. Another advantage is that the requirement of land for solar evaporation may be reduced.

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NAPPA GARMENT LEATHERS FROM GOAT SKINS

S.KULASEKARAN, DIPANKAR CHOWDHRY & K.S.JAYARAMAN

In order to supplement leathers for garments, goat appears as an alternative source because of dependable supply and highest growth rate. Experiments were therefore conducted to convert them into nappa garment leathers by suitably adjusting the processing conditions at the different stages. The details of the process that was found most satisfactory and now ready for commercial exploitation is presented.

Central Leather Research Institute, Madras

WATER PROOF SOFTY UPPER LEATHER

N.C.KRISHNAN, K.B.GUPTA, S.C.SUMATHI,V.V.M.RAO &
K.S.JAYARAMAN

A process for water proof softy buffalo upper using newly developed maleinised cotton seed oil fatliquor with chlorinated paraffin oil has been developed. The leathers are soft, full, smooth and withstand 48 hours static water absorption and 2 hours dynamic water absorption.

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EXPORT MARKETING OF LEATHER GOODS AND GARMENTS

N.LAKSHMINARAYANAN

India's position in the world market in the product sector has been discussed and the reasons for the relatively low state's share have been traced. Some suggestions have been made which eventhough may look unconventional, may prove effective in boosting up exports and getting a greater share in export market.

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SPECIALITY FATLIQUORS FOR PICKLELESS CHROME TANNAGE

K.B.GUPTA, N.C.KRISHNAN, S.C.SUMATHI, V.V.M.RAO &
K.S.JAYARAMAN

Use of phosphated and maleinised fatliquors of wool grease and cotton seed oil in the processing of pickleless cow softy upper has resulted in better feel, softness and fullness. Added advantages of this process are reduction of fatliquor consumption to almost 50% and reduction of pollution caused by the use of common salt in pickling of hides.

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EFFECT OF ELECTROLYTE ADDITIVES IN FATLIQUORS

K.VIJAYALAKSHMI, GEETHA BASKAR, K.S.JAYARAMAN
V.V.M.RAO AND S.RAJADURAI

The influence of various electrolytes such as chlorides, sulphates, silicates and phosphates as additives in fatliquors in the lubrication of chrome tanned leathers was examined. Stratigraphic analysis showed that salt added fatliquors effected a more even distribution and fixation of fat. The experimental leathers possessed better softness and strength.

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EVALUATION OF POLYURETHANE COATINGS FOR LEATHER

SANJEEV GUPTA, RAJESH KUMAR AND G.N.MATHUR

In this investigation, work has been carried out to synthesise .two component polyurethane formulations based on 2:2:4 and 2:6 Toluene di-isocyanate (80:20) and Poly oxy propylene glycol (Hydroxyl value 190) varying -NCO/OH ratio from 1.8 to 1.2 and -OH/NCO ratio from 1.8 to 1.2 respectively.

These isocyanate and hydroxyl terminated polyurethanes were characterised by determination of -NCO percentage and -OH percentage by titration method. Isocyanate and hydroxyl terminated polyurethane prepolymers were mixed accordingly and diluted by thinner butyl-acetate in the ratio 60:40 and then sprayed on base coated goat skins.

The effect of the polyurethane coatings were evaluated by various physical and finished properties viz. tensile strength, flexing endurance, wet and dry rub fastness, gloss, water-penetration, water vapour permeability of polyurethanes coated skins.

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ANATOMY OF FASHION
(with general reference to Leather products)

N.LAKSHMINARAYANAN

Brief historic review of Fashion - Western and Indian - Fashion definitions including the one as 'dynamic mechanism of change through which a potential object is transmitted from its point of creation to public introduction discernable public acceptance and eventual obsolesence - design and style defined. The various stages of fashion such as distinctiveness, emulation, mass adoption and declining phase are described. The modus operandi of fashion changes and the functionaries - characteristic features of fashion products such as FAD, high fashion, mass fashion, classics, colours defined - fashion trends as applicable to footwear with reference to shape, design, materials colours and treatment. Inter-related concepts of fashion in respect of awareness, interest, knowledgeability and perceived risk are explained. Various theories of fashion such as trickle down and up theory - categorisation of buyers of fashion products - diffusion of innovations based on relative advantage, comparability, complexity, trialability and communicability is explained. Fashion life cycle with regard to products - eight segments of consumers of fashion products who include innovators, opinion leaders, innovative communicators, fashion conscious consumers, fashion followers, fashion leggards, fashion derivatives and fashion disintegrators explained. Fashion trends and footwear - fashion trends in India and selected countries - conclusions and suggestions.

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DRYING CHARACTERISTICS OF LEATHER

D.S.ROOSEVELT*, R.KRISHNAMURTHY**, K.V.RAGHAVAN* AND K.S.JAYARAMAN*

Drying of leather is a complicated process. While the open/natural drying is less productive, the faster drying processes including radiation drying and the like processes could result in densening and damaging of the leather surface. To avoid these, a relatively slower process of drying with convection and conduction drying technique using an electrical drying chamber was developed. This paper presents the details of the chamber and the drying characteristics of leather dried in open and also in the chamber under conditions of 40°C and 60% RH.

Conclusions such as temperature and humidity for controlled drying, drying behaviour of chrome tanned cow hides, vegetable tanned goat skins have been studied. Rate of consumption of electrical energy during drying has also been reported.

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OBJECTIVE METHOD IN COLOUR MATCHING OF LEATHER

R.VENKATACHALAPATHY, R.RANGASWAMY, K.PARTHASARATHY
K.S.JAYARAMAN, K.V.RAGHAVAN AND R.B.MITRA

Modern method of colour matching of leather using instruments - Tristimulus colorimeter with microprocessor is presented. This objective technique using instrument is illustrated for matching fashion shades on full chrome sheep nappa and semi-chrome sheep suede leathers.

Central Leather Research Institute, Madras.

A STUDY ON A NEW CHROME EXHAUST AID 'TUFTAN C'

K.S.JAYARAMAN*, J.K.KHANNA*, D.H.KAMAT*
V.B.SINGH** & P.K.KAUSHIK**

The application of newly developed product "Tuftan-C" to be used exclusively during chrome tanning process to give additional chrome fixation has been described. Optimum quantity of Tuftan-C and the stage at which it has to be used for getting the beneficial effects of higher fixation of chrome has been worked out with supporting data.

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SPECIAL EFFECTS FOR VALUE ADDITION

K Parthasarathy, S Ramalingam, B Ramaniah, KS Jayaraman

ABSTRACT

With the view to utilise the lower ends to get better returns, a few approaches have been made to mask the grain defects of the lower ends by suitable techniques.

1. Mosaic Effect

Different coloured seasons are sprinkled on the leather by adjusting the air pressure and composition of the season. A mosaic effect is thus obtained which conceals most of the grain defects.

2. Rain Drop Effects

After covering the surface defects by heavy bottom coat with high amount of pigment and lacquering, a preformed polyurethane solution cut with suitable solvent is sprayed on the leather to produce the speckled effect. If required, the polyurethane can also be tinted with solvent soluble dyestuffs to get coloured effect.

Central Leather Research Institute, Madras

TWO TONE SPLIT SUEDES

C Muralidharan, R Ramesh, KS Jayaraman

ABSTRACT

Splits, the by-products of processing of wet blue hides, offer a tremendous scope for the tanners to increase their returns, if utilised in a better way. One such approach being production of two-tone suede, which could be utilised for footwear and leathergoods manufacture. This would enhance the aesthetic appeal apart from fetching better returns.

The principle behind this method is to produce contrast colours between the inner and outer layers of the split by suitable choice of dyestuffs with penetrating and surface dyeing characteristics. Subsequent printing and buffing of the leathers produce a two-tone effect. The nature and penetrating power of the dyestuffs and charge of the leather play a vital role in successful production of the two-tone effect.

Central Leather Research Institute, Madras

UPGRADING OF LOWER ENDS - GOAT AND SHEEP CRUST

N Samivelu, S Krishnan, V Rathinasamy, KS Jayaraman

ABSTRACT

Even though India can boast of quality goat and sheep skins, there is still about 30% of the skins which suffer from some grain damage. It is necessary that these defective leathers are upgraded to get beter returns. Two approaches have been tried.

The defective crust leathers (after assortment) are printed with suitable deep prints, snuffed, wet back, byed and refatliquored. These dyed leathers are dry drummed and toggled. By this technique, it has been possible to obtain grain and suede effect on the same side of the skin.

Another approach has been to give a bottom coat either with protein formulation or resin formulation containing large proportion of pigment, embossing with suitable design plates and tipping effect produced with a contrast colour in a roller coating machine. By the above approach, it has been possible to camauflage the defects and the upgraded leathers can be used for the manufacture of value added product items.

Central Leather Research Institute, Madras

AQUEOUS POLYURETHANE DISPERSIONS IN LEATHER FINISHING

Maurice J Osgood

Aqueous polyurethane dispersions are most important leather finishing materials. The present article highlights the development of water borne polyurethanes based on polyesters. It also includes a comparison of other leather finishing agent like the acrylic and protein based systems. The effect of pH and particle on the property of urethane emulsions have been examined. Major application include upgradation of leathers. In the case of PVC based uppers the plasticized migration is totally avoided by the use of PU emulsions. In conclusion the properties of the PU emulsions have been analysed in terms of cost and performance.

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DESIGN, DEVELOPMENT AND FABRICATION OF SPORT SHOES-A BIOMECHANICAL APPROACH

M Vengatachalam*, DLV Rao*, B Venkatappaiah*,
KV Raghavan

Videographic technique has been used to acquire data on kinematic parameters of athletic feet. The subjects chosen were the participants in the 1988 Olympic track events. The events studied include i) 100 metre running - Men and Women ii) 200 metre running - Men iii) Running portion in Triple Jump - Men and Women iv) 10,000 metre running - Men v) 400 metre hurdles - Men. The parameters obtained were displacements, velocity and acceleration of knee joint, Ankle joint and MTP joint of the leg. An attempt was made to determine the x and y components (ie in the direction of motion and perpendicular to that) of the forces at those joints during different phases of the gait cycle with particular reference to foot-ground contact phase. An attempt was also made to correlate the results with the material properties in order to optimize the athletic footwear design.

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*Central Leather Research Institute.

QUALITY CONTROL IN FOOTWEAR

M. Koteswara Rao

'QUALITY CONTROL' is the key to boost up exports of footwear now gaining momentum. Quality Control is prescribing the qualities to be measured - their quantum and the methods of measurements and therefore does not aim at perfection but only identifies the limits of permissible defects. With this definition, the other objectives, the techniques such as (i) Physical Inspection and their Organisation and (ii) Statistical controls for ensuring quality control are reviewed. And the actual methods now in use within the country are discussed with particular reference to benefits like better quality and higher productivity with minimum cost.

Central Leather Research Institute, Madras.

EFFECT OF SODIUM CHLORIDE ON VARIOUS MORPHOLOGICAL AND BIO-CHEMICAL CHARACTERISTICS OF PADDY SEEDLINGS

T.Leelapriya, S.C.Nandy[*]
P.T.Kalaichelvan[**]

Sodium chloride, a major constituent of tannery effluent, is well recognised for its adverse affect on plant growth. Salinity affects plant morphology as well as plant metabolism and extreme salinity may even inhibit plant growth. In the present investigation the effect of salinity on the various morphological and biochemical characteristics of one salt tolerant (Var: AU-1) and one salt sensitive (Var: IR-50) variety of paddy during early seedling growth has been studied.

Salinity affected all the morphological characteristics such as percent germination, height of seedlings, fresh and dry weights, etc. and the biochemical parameters like chlorophyll, carotenoids, total protein, total carbohydrates, total lipids, total amino acids, proline, nucleic acids, ascorbic acid, & amylase, succinic dehydrogenase and membrane permeability quite significantly. Both the salt tolerant and salt sensitive varieties of paddy were equally susceptible to the adverse affects of salinity. Proline synthesis by the seedlings is known to be enhanced under stress condition in presence of sodium chloride but when 50 ppm L-proline was incorporated to the salt medium, proline synthesis was found to be practically inhibited. Morphology and metabolism of Phaseolus aureus (green gram) were also identically affected by sodium chloride.

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[*] Central Leather Research Institute, Madras.

[**] C.A.S. BOTANY, University of Madras.

FUNGAL GROWTH IN LEATHER AS INFLUENCED BY FATLIQUORING AND FINISHING

G. Suseela Rajakumar, R.Ramesh & S.C.Nandy*

The influence of various fat liquors and finishing agents on fungal growth in leather was investigated. Fat liquors based on synthetic oil, vegetable oil, fish oil and mineral oil were tried but they showed practically no inhibitory effect on fungal growth. Amongst the finishing agents, polyurethane finish was the most effective in preventing fungal growth in leather followed by aniline finish whereas protein finish was found to be the least effective.

Fungicides like Busan-30 and Sodium pentachlorophenate applied during fat liquoring prevented fungal growth in fatliquored leather at 0.05 and 0.1% concentrations respectively but higher concentrations of the fungicides (0.1% Busan-30 and 0.3% Sodium pentachlorophenate) were needed to inhibit fungal growth in resin finished leather. When the fungicides were incorporated during resin finish, 0.2% Busan and 0.3% Sodium pentachlorophenate were required to prevent fungal growth. The results obtained also indicate that the antifungal resistance to leather is not altered whether the fungicide is applied during fat liquoring in one instalment or applied in two different stages

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* Central Leather Research Institute, Madras.

POTENTIOTITRIMETRIC DETERMINATION OF SULPHIDE USING SULPHIDE ION-SELECTIVE ELECTRODE

S. Ali Mansoor* & P. Riyazuddin*
S. Sadulla**

The performance of graphite coated with silver sulphide electrode [A. Palanivel and P. Riyazuddin, J. Chem. Educ.61, 920 (1984)] has been evaluated in potentiometric titration of sulphide in unhairing bath using cadmium, zinc and silver ion-solutions as titrants. Experimental conditions and results will be described.

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* Dept. of Analytical Chemistry, University of Madras, Guindy Campus, Madras-25.
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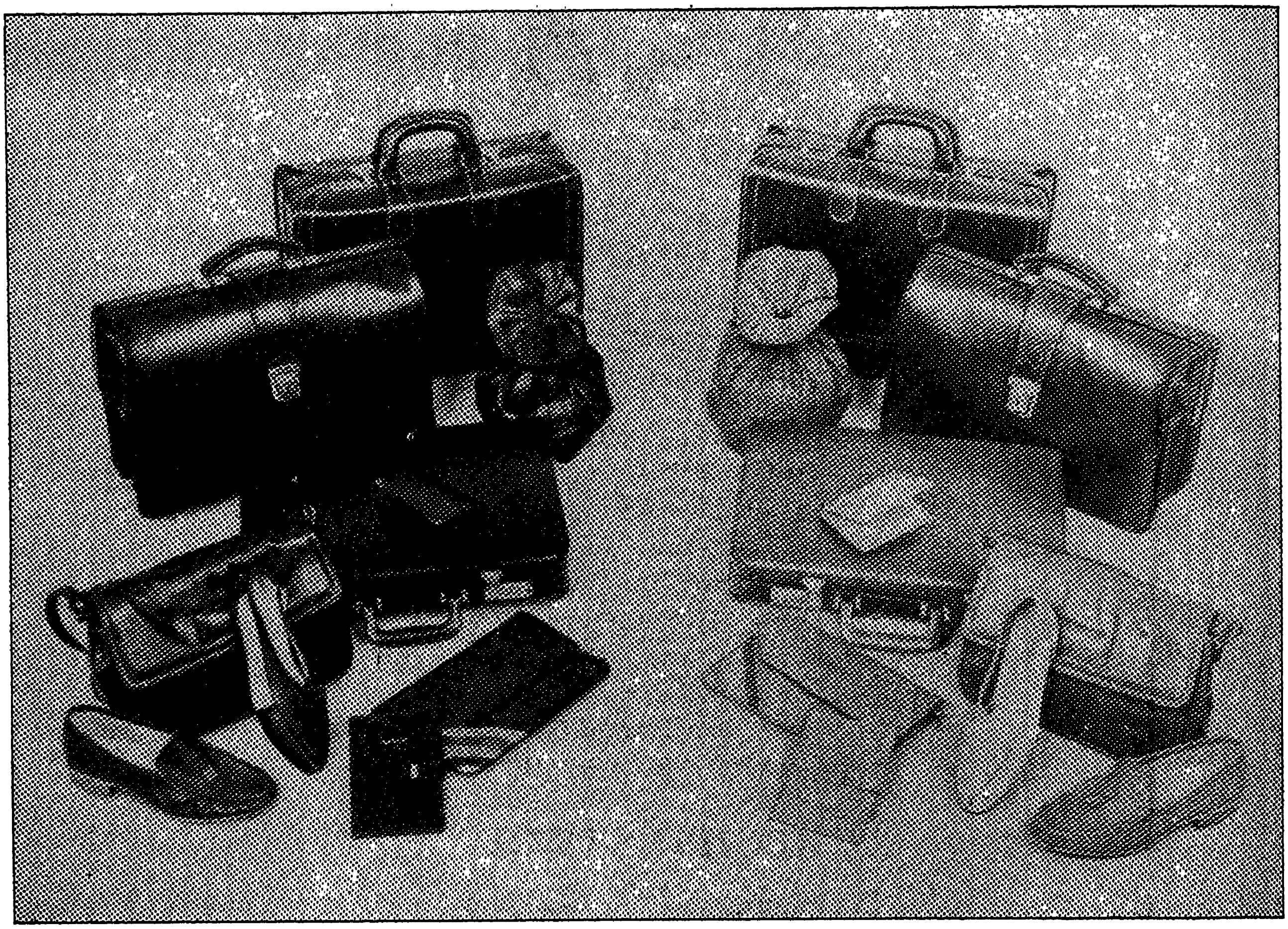

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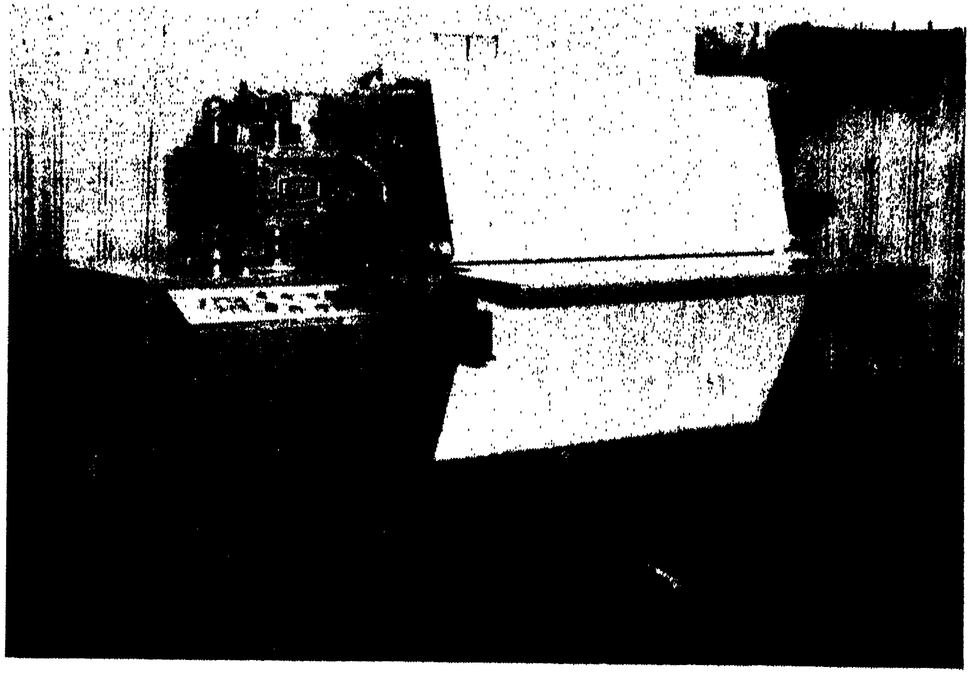

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